| FORM PTO-1390
REV. 5-93
**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371** | US DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE | ATTORNEYS DOCKET NUMBER
P02,0000

U.S.APPLICATION NO. (if known, see 37 CFR 1 5)
10/049466 |

| INTERNATIONAL APPLICATION NO.
PCT/DE00/03581 | INTERNATIONAL FILING DATE
12 October 2000 | PRIORITY DATE CLAIMED
19 October 1999 |

TITLE OF INVENTION

METHOD FOR ENGRAVING PRINTING CYLINDERS

APPLICANT(S) FOR DO/EO/US

ERNST-RUDOLF GOTTFRIED WEIDLICH

Applicant herewith submits to the United States /Designated/Elected Office (DO/EO/US) the following items and other information

1. ■ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. □ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. ■ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay
4. □ A proper Demand for International Preliminary Examination will be made by the 19th month from the earliest claimed priority date

5. ■ A copy of International Application as filed (35 U.S.C. 371(c)(2))
   a. ■ is transmitted herewith (required only if not transmitted by the International Bureau)
   b. □ has been transmitted by the International Bureau.
   c. □ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ■ A translation of the International Application into English (35 U.S.C. 371(c)(2).

7. ■ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3))
   a. □ are transmitted herewith (required only if not transmitted by the International Bureau)
   b. □ have been transmitted by the International Bureau.
   c. □ have not been made; however, the time limit for making such amendments has NOT expired
   d. ■ have not been made and will not be made.

8. □ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3))

9. ■ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). **Executed**

10. □ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:
11. ■ An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98; **(PTO 1449, Prior Art, Search Report).**

12. ■ An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included
   (SEE ATTACHED ENVELOPE)

13. ■ A FIRST preliminary amendment.
   □ A SECOND or SUBSEQUENT preliminary amendment.

14. ■ A substitute specification - **Marked up copy of Substitute Specification**.

15. □ A change of power of attorney and/or address letter.

16. ■ Other items or information:
   a. ■ Submission of Drawings - **Eight sheets of drawings**
   b. ■ EXPRESS MAIL #EL 843743016 US - February 12, 2002
   c. ■ PETITION TO REVIVE ABANDONED APPLICATION UNDER 37 C.F.R. § 1.137

U.S. APPLICATION NO (if known. See 37 CFR 1 5) **10/049466**	INTERNATIONAL APPLICATION NO PCT/DE00/03581	ATTORNEY'S DOCKET NUMBER P02,0000

BASIC NATIONAL FEE (37 C.F.R. 1.492(a)(1)-(5):

Search Report has been prepared by the EPO or JPO $890 00

International preliminary examination fee paid to USPTO (37 C.F.R. 1.482) $710.00

No international preliminary examination fee paid to USPTO (37 C.F.R. 1.482) but international search fee paid to USPTO (37 C.F.R. 1.445(a)(2) $740.00

Neither international preliminary examination fee (37 C.F.R. 1.482) nor international search fee (37 C.F.R. 1.445(a)(2) paid to USPTO $1040.00

International preliminary examination fee paid to USPTO (37 C.F.R. 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) .... $ 100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =	$890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).	$ 0	

Claims	Number Filed		Number Extra	Rate		
Total Claims	10	- 20 =	0	X $ 18.00	$	
Independent Claims	2	- 3 =	0	X $ 84.00	$	
Multiple Dependent Claims				$280.00 +	$	
TOTAL OF ABOVE CALCULATIONS =					$ 890.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 C.F.R. 1.9, 1.27, 1.28)					$	
SUBTOTAL =					$ 890.00	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +					$	
TOTAL NATIONAL FEE =					$	
Fee for recording the enclosed assignment (37 C.F.R. 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). $40.00 per property +						
TOTAL FEES ENCLOSED =					$ 890.00	
					Amount to be refunded	$
					charged	$

a. ■ A check in the amount of $ __890.00__ to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **501519**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SIGNATURE

SEND ALL CORRESPONDENCE TO:

Schiff Hardin & Waite
Patent Department
6600 Sears Tower
Chicago, Illinois 60606
CUSTOMER NO. 26574

Brett A. Valiquet
NAME

27,841
Registration Number

1

BOX   PCT

IN THE UNITED STATES ELECTED OFFICE

OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

UNDER THE PATENT COOPERATION TREATY

5   **PRELIMINARY AMENDMENT**

APPLICANT: Ernst-Rudolf Gottfried Weidlich

DOCKET NO: P02,0000

SERIAL NO: GROUP ART UNIT:

EXAMINER:

10   INTERNATIONAL APPLICATION NO: PCT/DE00/003581

INTERNATIONAL FILING DATE: 12 October 2000

INVENTION: **"METHOD FOR ENGRAVING PRINTING CYLINDERS"**

Assistant Commissioner for Patents,

Washington, D.C.   20231

15   Sir:

As a Preliminary Amendment for entry into the
National Stage for the above-identified PCT application,
the following is submitted:

IN ABSTRACT:

20   Please add the following Abstract:

--In a method for engraving printing cylinders in
an electronic engraving machine, printing densities are
matched in individual engraving lanes by engraving cups
in the printing lanes with which the prescribed
25   characteristic rated printing densities are to be

achieved. The actual printing densities are identified by measurement after the printing. A corrected lane calibration is derived for the respective engraving lane from deviations between the rated printing densities and

5   the actual printing densities. The allocated corrected lane calibration is applied in the engraving lanes.--

IN THE DRAWINGS:

Please amend Fig. 1 of the drawings in accordance with the attached Drawing Correction Letter.

10   **IN THE SPECIFICATION:**

Please enter the Substitute Specification enclosed. No new matter is entered in the substitute specification. A marked-up copy of the Substitute Specification showing changes made is enclosed.

15   **IN THE CLAIMS:**

Please cancel claims 1-10 without prejudice.

Please add new claims 11-21 as follows:

11. A method for engraving printing cylinders in an electronic engraving machine, comprising the steps of:

20   engraving at least two engraving lanes that lie next to one another in an axial direction on a printing cylinder with a respectively allocated engraving element;

generating signal values that represent rated density values to be achieved for drive of the engraving

25   elements;

with the engraving elements driven with the signal values engraving cups into the printing cylinder whose

3

geometry values represent actual printing densities that have been achieved;

prescribing a standard calibration function that describes a relationship between the geometry values and
5   the rated printing densities;

calibrating electrical properties of the engraving elements such that, given drive of the engraving elements with signal values belonging to characteristic rated printing densities, cups having geometry values
10   prescribed by the standard calibration function are engraved; and

matching the printing densities in the individual engraving lanes by

engraving cups in the printing lanes with
15   which the prescribed, characteristic rated printing densities are to be achieved,

identifying the actual printing densities achieved by measurement after the printing,

deriving a corrected lane calibration for
20   the respective engraving lane from deviations between the rated printing densities and the actual printing densities, and

applying the allocated, corrected lane calibration in the engraving lanes.

25

12.   The method according to claim 11 wherein the corrected lane calibration is generated by determining corrected geometry values for the rated printing densities in the standard calibration function.

13.   The method according to claim 11 wherein the geometry values of a cup are at least one of transverse diagonals, longitudinal diagonals, cup area and cup volume.

14.   The method according to claim 14 wherein the corrected lane calibration is generated in that corrected signal values are determined for the signal values.

15.   The method according to claim 11 wherein improved corrected lane calibrations are determined anew when deviations between the rated printing densities and the actual printing densities exceed a tolerance limit.

16.   The method according to claim 11 wherein improved, corrected lane calibrations are determined anew after a prescribed time interval after a prescribed number of engraved printing cylinders or after a prescribed frequency of use of the engraving element.

17.   The method of claim 14 wherein improved, corrected lane calibrations are determined by extrapolation from a time variation of the determined, corrected geometry values or the corrected signal values.

18.   The method according to claim 11 wherein the measurement of the actual printing densities and of the geometry values is implemented by automatic measurement devices.

19. The method according to claim 11 wherein said measurements and the derived corrected lane calibration as well as time dependencies are stored and administered in a central computer.

5   20. The method according to claim 11 wherein corrected lane calibrations are continuously automatically adapted to varying properties of the engraving elements and of the engraving lanes.

21. A method for engraving printing cylinders in
10   an electronic engraving machine, comprising the steps of:
       engraving at least two engraving lanes on a printing cylinder with a respectively allocated engraving element;
       generating signal values that represent rated
15   density values to be achieved for drive of the allocate engraving element;
       with the engraving elements driven with the signal values engraving cups into the printing cylinder whose geometry values represent actual printing densities that
20   have been achieved;
       prescribing a standard calibration function that describes a relationship between the geometry values and the rated printing densities;
       calibrating electrical properties of the engraving
25   elements such that, given drive of the engraving elements with signal values belonging to characteristic rated printing densities, cups having geometry values

prescribed by the standard calibration function are engraved; and

matching the printing densities in the individual engraving lanes by

5
    engraving cups in the printing lanes with which the prescribed, characteristic rated printing densities are to be achieved,

    identifying the actual printing densities achieved by measurement after the printing,

10
    deriving a corrected lane calibration for the respective engraving lane from deviations between the rated printing densities and the actual printing densities, and

    applying the respective corrected lane

15
calibration in the engraving lanes.

REMARKS

An Information Disclosure Statement is enclosed.

The new claims presented are not narrower then the

20
original claims so that the *Festo* decision does not apply. Furthermore, these new claims presented merely convert the claims in the PCT prosecution in acceptable

format in the U.S.   An additional independent claim 21
is also provided.

Respectfully submitted,

5

(signature)   (Reg. No. 27,841)
Brett A. Valiquet
Schiff Hardin & Waite
10   Patent Department
6600 Sears Tower
Chicago, Illinois 60606
Telephone: 312-258-5786
ATTORNEY FOR APPLICANT
15   **CUSTOMER NUMBER 26574**

CHI_DOCS2 CS2\531312 1 01 24 02 09 36

<u>S P E C I F I C A T I O N</u>

<u>T I T L E</u>

"METHOD FOR ENGRAVING PRINTING CYLINDERS"

<u>**BACKGROUND OF THE INVENTION**</u>

5   The invention is in the field of electronic reproduction technology and is directed to a method for engraving printing cylinders in an electronic engraving machine, whereby at least two engraving lanes that lie next to one another in axial direction are engraved on a printing cylinder with a respective engraving element.

10   DE-C-25 087 34 already discloses an electronic engraving machine for engraving printing cylinders with an engraving element. The engraving element, having an engraving stylus controlled by an engraving control signal as a cutting tool, for example in the form of a diamond, moves in the axial direction along a rotating printing cylinder. The engraving stylus cuts a sequence of cups

15   arranged in a printing raster into the generated surface of the printing cylinder. The engraving control signal is formed in an engraving amplifier by superimposition of a periodic raster signal, also referred to as vibration, with image signal values that represent the printing densities between "light" and "dark" to be reproduced. Whereas the raster signal effects an oscillating lifting

20   motion of the engraving stylus for engraving the cups arranged in the printing raster, the image signal values determine the cut depths of the engraved cups in conformity with the tonal values to be reproduced.

          For magazine printing, a plurality of strip-shaped cylinder regions called engraving lanes that lie axially next to one another must be simultaneously

25   engraved with a respective engraving element on a printing cylinder or[, respectively,] on the printing cylinders of a color set that are successively engraved in one engraving machine or, on the other hand, simultaneously engraved in a plurality of engraving machines. For example, the various printed pages of a print job are produced in the individual engraving lanes. The

engraving control signals for the individual engraving elements are thereby generated in separate electronic units, referred to as engraving channels.

A pre-requisite for a good reproduction quality is that the engraved printing densities in the individual engraving lanes coincide, i.e. that what is referred to as a lane equality is achieved. Even when the individual engraving channels are electrically balanced, the engraving styli often exhibit different degrees of wear. The result is that cups having different geometrical dimensions or[, respectively,] volumes are engraved in the individual engraving lanes, as a result [whereof] of which disturbing differences in printing density occur in the engraving lanes. Worn engraving styli also generate cups with a rougher inside surface, as a result [whereof] of which the ink acceptance behavior in the printing machine and, thus, the printing density are varied. Different printing densities in the engraving lanes can also be attributed to influences in the printing machine, for example when the pressing power between printing cylinder and cooperating printing cylinder varies in the axial direction or when the doctor blade with which excess ink is stripped off does not lie against the printing cylinder with the same tightness everywhere.

In order to achieve identical printing densities in the engraving lanes, engraving styli having the same degree of wear are currently sought insofar as possible for the engraving. As a precautionary measure, the engraving styli are also replaced by new engraving styli after a specific number of operating hours, this being relatively involved and expensive.

Even when new engraving styli are employed, density differences due to engraved areas that differ in size can soon arise in the individual engraving lanes as can, connected therewith, wear of the engraving styli that occurs with differing [in] repetity. Different engraving properties such as the hardness of the material and the cutting behavior of the engraving stylus in the material - whereby the material is generally copper - can, for example, arise due to a non-uniform galvanization of the printing cylinder.

The differences in printing density in the engraving lanes can occur with respect to one printing density value or with respect to a printing density range

and can differ in size for each engraving lane. Additionally, the engraving properties can change at the circumference of the printing cylinder, so that differences in printing density can also occur within an engraving lane.

For matching such differences in printing density, the engraved printing cylinder is currently chemically post-processed in practice in a time-consuming and work-intensive work process, particularly given high quality commands made of the printed products printed with the cylinder.

SUMMARY OF THE INVENTION

[The invention is therefore based on the object of improving a method for] It is an object of the invention to improve upon engraving of printing cylinders in an electronic engraving machine, [whereby] wherein at least two engraving lanes [that lie side-by-side in axial direction] are engraved with a respectively allocated engraving element on a printing cylinder, such that disturbing differences in printing density are automatically compensated in the engraving lanes.

[This object is achieved by the features of claim 1. Advantageous developments are recited in the subclaims. The invention is described in greater detail below on the basis of Figures 1 through 9. Shown are:]

In accordance with a method of the invention for engraving printing cylinders in an electronic engraving machine, printing densities in the individual engraving lanes are matched by engraving cups in the printing lanes with which the prescribed characteristic rated printing densities are to be achieved. The actual printing densities achieved are identified by measurement after the printing. A corrected lane calibration is derived for the respective engraving lane from deviations between the rated printing densities and the actual printing densities. The allocated, corrected lane calibration is applied in the engraving lanes.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the relationship between signal value and printing density for three characteristic rated density values;

Fig. 2 <u>shows</u> the relationship between the rated density values and the rated transverse diagonals corresponding to them (standard calibration function);

Fig. 3 <u>illustrates</u> the residual deviations of the actual printing densities for three characteristic tonal values and for the individual engraving lanes;

Fig. 4 <u>shows</u> the residual deviations between actual printing densities and rated printing densities in an engraving lane;

Fig. 5 <u>illustrates </u>the correction function $\Delta Q = f(Q)$ for an engraving lane;

Fig. 6 <u>shows</u> the corrected calibration function for an engraving lane;

Fig. 7 <u>illustrates</u> the correction of the signal values;

Fig. 8 <u>shows</u> the allocation between signal values and corrected signal values; and

Fig. 9 <u>illustrates</u> the variation of the geometry values over time.

<u>DESCRIPTION OF THE PREFERRED EMBODIMENTS</u>

<u>For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the preferred embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and/or method, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur now or in the future to one skilled in the art to which the invention relates.</u>

According to the prior art, rated printed densities D_{rated} for characteristic tonal values of a test wedge to be engraved are prescribed in every engraving lane of a printing cylinder for calibrating the printing density D. The test wedge, for example, comprises three characteristic tonal values having the rated printed densities D_{rated} = (0.25; 0.5; 0.8). The signal values S = (161; 80; 1) with which the engraving system is driven belong thereto. Fig. 1 shows the relationship between the signal values S and the printing densities D. A test wedge with the prescribed signal values S is engraved in each engraving lane on a printing cylinder. The engraving of the test wedges on the printing cylinder can [ensue] <u>occur</u> separately from or simultaneously with the engraving of the actual printing

form in cylinder regions lying outside the printing form. Likewise, regions of the production engraving can also be utilized for the calibration when they contain the characteristic tonal values. After the engraving of the printing cylinder, the engraved printing cylinder is proof printed in a printing machine. In the proof printing, the actual printing densities D_{actual} achieved for the test wedges engraved in the individual engraving lanes are measured with a suitable density measuring instrument, and the deviations from the rated printed densities D_{rated} are identified (Fig. 1). These deviations are compensated in the individual engraving lanes with a suitable calibration of the transfer function of the engraving systems, for example by setting the signal gain and the activation point of the amplification of the engraving systems.

Since new proof prints cannot be constantly made for reasons of [outlay] <u>expense</u> during the setting of the engraving systems in order to identify the actual printing densities D_{actual} that have already been achieved, the actual printing densities D_{actual} are derived from the measurement of geometry values of the engraved test wedge cups. Rated geometry values that define the desired shape and size of the cups to be engraved correspond to the prescribed rated density values D_{rated}. Geometry values can be the longitudinal diagonals, the transverse diagonals, the areas or volumes of the cups dependent on which measuring method is employed for measuring the engraved cup size. Preferably, the transverse diagonals of the cups are utilized since they are simple to measure. Fig. 2 shows the relationship between the rated printing densities D_{rated} and the rated transverse diagonals Q_{rated} of the cups corresponding to them. Given the standard collaboration function, the rated transverse diagonals Q_{rated} = (30 µm; ;100 µm; 170µm) correspond to the characteristic rated printing densities D_{rated} = (0.25; 0.5; 0.8).

The rated printing densities D_{rated} are converted into the corresponding signal values for driving the engraving amplifiers allocated to the individual engraving lanes, the engraving control signals for controlling the engraving styli of the engraving elements being generated in [said] <u>the</u> engraving amplifiers. The actual geometry values of the cups that are achieved are measured in every

engraved test wedge of an engraving lane. The measurement of the geometry values can [ensue] <u>occur</u> with the assistance of a measuring microscope or in a video image registered by a video camera. The engraving systems of the individual engraving lanes are set such that the actual geometry values reach the rated geometry values that correspond to the prescribed rated printing densities.

5   A standard calibration function between the rated printing densities D_{rated} and, for example, the rated transverse diagonals Q_{rated} corresponding to them (Fig. 2) is employed for this collaboration according to the prior art, [said] <u>the</u> rated transverse diagonals Q_{rated} having been determined for a new engraving stylus and having been defined by averaging over a plurality of engraved test

10   wedges and proof printings. The result thereof is that the influences differing from engraving lane to engraving lane that were initially explained such as degree of wear of the engraving stylus, ink acceptance behavior, hardness of the material, cutting behavior, etc., are not taken into consideration in the collaboration. After the collaboration, the actual printing densities D_{actual} in the

15   individual engraving lanes can therefore still deviate from the rated printing densities D_{rated}. Fig. 3 shows these residual deviations of the actual print densities D_{actual} for the three characteristic tonal values and for the individual engraving lanes.

        [According to the inventive] <u>In the</u> method <u>disclosed, of the preferred</u>

20   <u>embodiment</u>, correction values are derived from the residual deviations for the individual engraving lanes, said correction values being taken into consideration in the next engraving of a printing cylinder with the same engraving system in the respective engraving lane in the collaboration, so that the calibration takes the lane-individual influences and differences into consideration, and, thus, the rated

25   printed densities are achieved more dependably and more exactly in all engraving lanes. The method is explained below with reference to the example of engraving lane number 1. [To this end] <u>For this purpose</u>, Fig. 4 shows the rated printing densities D_{rated} and the actual printing densities D_{actual} achieved in this engraving lane after the standard calibration dependent on the transverse diagonals Q. The

30   residual deviations between rated printing densities D_{rated} and actual printing

densities D_{actual} has been entered highly exaggerated in Fig. 4 in order to be able to clearly present [the inventive method] <u>a preferred embodiment of the method</u>. According to the standard calibration, a transverse diagonal of Q_{rated} = 100µm is set (Point A) for the value D_{rated} = 0.5 of the rated printing density. The actual printing density D_{actual} achieved therewith is higher by the residual deviation ΔD

5   (Point B). Corresponding deviations derive for the other characteristic tonal values for which the transverse diagonals Q_{rated} = 30µm or, respectively, Q_{rated} = 170µm had been set in the engraving. When the points of the actual printing densities D_{actual} that are achieved for the three characters to tonal values are connected in this diagram, then the broken-line curve of the actual printing

10   density is obtained. According to the curve of the actual printing densities, the rated printing density value D_{rated} = 0.5 is achieved in Point C, i.e. with a transverse diagonal deviating by ΔQ = -16µm. [When, thus,] <u>Thus when</u> the corrected transverse diagonal Q_{corr} = 100µm + ΔQ = 84µm is set for the rated printing density value D_{rated} = 0.5 in the next engraving in this engraving lane, the

15   rated printing density value D_{rated} is exactly achieved or is at least achieved with far greater precision. Based on the same consideration, correction values ΔQ for the various values of the transverse diagonals can be derived from the comparison of the curves for the rated printing density D_{rated} and actual printing density D_{actual}. An individual correction function ΔQ = f(Q) ultimately derives

20   therefrom for each engraving lane, this being shown in Fig. 5 for the example under consideration. This correction function can also be immediately taken into consideration in the standard calibration function according to Fig. 2 as well, as a result [whereof] <u>of which</u> a lane calibration function is obtained that is employed in the next production engraving for this engraving lane (Fig. 6).

25   The actual printing densities D_{actual} achieved with the cups engraved in the test wedges and the potentially remaining residual deviations relative to the rated printing densities D_{rated} are identified in (Fig. 3) after one or more renewed production engravings of a printing cylinder with the same engraving systems in the individual engraving lanes or are also identified at certain regular time

30   intervals. In the way set forth above, an improved lane calibration function is

calculated therefrom (Fig. 6), this then being employed in the following production engravings. Expediently, the calculation of a new lane calibration [ensues] <u>occurs</u> when the residual deviations between the rated printing densities D_{rated} and the actual printing densities D_{actual} have exceeded a prescribed tolerance limit. The calibration of the engraving lanes thus [ensues] <u>occurs</u> in a process of "self-learning" wherein the settings of the engraving amplifiers in the individual engraving channels are continuously optimally adapted to the varying technical boundary conditions such as, for example, differing degrees of wear of the engraving styli employed.

The [inventive] calibration method <u>preferred embodiment</u> for density matching of the engraved lanes has been explained with reference to the example of setting the engraving channels with the transverse diagonals of the engraved cups. The method can be implemented in the same way when the transverse diagonal is replaced by some other geometry value of the engraved test wedge cups, for example the longitudinal diagonals, the area or the volume of the cups. Analogous to the relationship of Fig. 2, a standard calibration function is employed for this purpose that places the geometry value employed into relationship with the rated printing densities D_{rated}. After setting the rated geometry values according to this standard calibration function, the actual printing densities D_{actual} of the engraved test wedges are measured, and individual corrections of the geometry value employed are derived therefrom for the individual engraving lanes in order to erect a lane calibration function (analogous to Fig. 4 and Fig. 5).

An improved precision of the [inventive] calibration method <u>example provided</u> can be achieved when the setting of the geometry value employed [ensues] <u>occurs</u> not only for the three characteristic rated printing densities but also [ensues] <u>occurs</u> for further intermediate stages, for example for tonal values in a graduation of 10% between light and dark.

In another embodiment of the [inventive] calibration method, the signal values S with which the engraving channels are driven are individually corrected for every individual lane instead of the geometry value employed. This is

illustrated in Fig. 7 that shows the relationship between the signal values S and the printing densities D (see Fig. 1). The rated printing densities D_{rated} and the actual printing densities D_{actual} achieved in a specific engraving lane following the standard calibration are entered dependent on the drive signal values S. A signal value S = 80 (Point E) was applied for driving for the value D_{rated} = 0.5 of the rated

5   printing density. The actual printing density thus achieved is higher by the residual deviation ΔD (Point F). Corresponding deviations derived for the other characteristics tonal values for which the signal values S = 1 or, respectively, S = 161 had been applied in the engraving. When the points of the actual printing densities D_{actual} that were achieved for the three characteristic tonal values are

10   connected in this diagram, then the broken-line curve of the actual printing densities is obtained. According to the curve of the actual printing densities, the rated printing density value D_{rated} = 0.5 is reached in the Point G, i.e. with a signal value deviating by ΔS = 15. [When, thus,] Thus when the corrected signal value S_{corr} = 80 + ΔS = 95 is applied in the next engraving in this engraving lane for the

15   rated printing density value D_{rated} = 0.5, the rated printing density value D_{rated} is exactly achieved or is at least achieved with far greater precision. Based on the same consideration, correction values ΔS for all signal values S can be derived from the comparison of the curves for the rated printing density D_{rated} and the actual printing density D_{actual}. An individual correction function S_{corr} = g(S) for the

20   signal values ultimately derives therefrom for each engraving lane, this being shown in Fig. 8 for the example under consideration. This correction function can, for example, be realized by a table memory in each engraving channel, a corrected signal value S_{corr} being allocated to every input signal value S therewith. In this embodiment of the [inventive] calibration method, care must be exercised

25   to see that the actual printing density D_{actual} for the smallest signal values S has values that are higher than or equal to the rated printing density D_{rated}, since negative signal values would otherwise have to be generated by the calibration. This condition can be assured, for example, by an enhanced pigmentation of the ink, whereby the pigmentation of the ink must be enhanced to such an extent that

30   the above condition is met in all lanes.

In another development of the [inventive] calibration method, the time variation of the residual deviations between actual printing density D_{actual} and rated printing density D_{rated} in the individual engraving lanes is additionally taken into consideration in order to make a prediction about the anticipated residual deviations and, thus, about the anticipated changes in the lane calibration function. One reason for the time variation is the progressive wear of the engraving stylus with age or[, respectively,] the frequency with which the engraving stylus is used. Different degrees of wear of the engraving styli can be caused in that areas of different size were previously engraved in the engraving lanes and/or the engraving lanes exhibit different engraving properties that, for example, are to be attributed to a non-uniform galvanization of the printing cylinder.

Fig. 9 shows the time dependency for a lane of the transverse diagonals Q for the three characteristic tonal values to be set in the lane calibration according to the [inventive] method. It is assumed that the transverse diagonals Q to be set were already redetermined at the respective time interval T for two matching periods of the lane calibration. A prediction for the variation of the transverse diagonals Q to be set in the next engravings can then be made (broken-line part of the curves) from the slope that the curves have been reached at time 2T, the exact values being in turn determined from the measurement of the actual printing densities D_{actual} by time 3T. As a result of this extrapolation, the measurement and matching of the lane calibration need not be implemented as often. Instead of being entered dependent on the time, the variation of the geometry values relevant for the calibration can also be entered, for example, dependent on the frequency with which the engraving styli are used in order to derive the prediction about the setting values for the next engravings. The frequency of the use can, for example, be measured in that the cumulated number of engraved cups is summed up in a counter that is present in every engraving channel.   Alternatively, this number can also be determined in the control software and [be] stored.

In an advantageous embodiment [of the invention], the measurements of the actual printing densities and the geometry values that are set are undertaken by automatic measuring devices. It is also advantageous to store and administer the measured values and the identified setting values for the individual lane calibrations as well as the time dependencies and development tendencies in a

5   central computer, so that the density match in between the individual engraving lanes automatically sequence it and is also automatically adapted to the change in technical boundary conditions over a longer time.

While a preferred embodiment has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered

10   as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention both now or in the future are desired to be protected.

SUBSTITUTE SPECIFICATION

S P E C I F I C A T I O N

T I T L E

"METHOD FOR ENGRAVING PRINTING CYLINDERS"

BACKGROUND OF THE INVENTION

5   The invention is in the field of electronic reproduction technology and is directed to a method for engraving printing cylinders in an electronic engraving machine, whereby at least two engraving lanes that lie next to one another in axial direction are engraved on a printing cylinder with a respective engraving element.

10   DE-C-25 087 34 already discloses an electronic engraving machine for engraving printing cylinders with an engraving element. The engraving element, having an engraving stylus controlled by an engraving control signal as a cutting tool, for example in the form of a diamond, moves in the axial direction along a rotating printing cylinder. The engraving stylus cuts a sequence of cups

15   arranged in a printing raster into the generated surface of the printing cylinder. The engraving control signal is formed in an engraving amplifier by superimposition of a periodic raster signal, also referred to as vibration, with image signal values that represent the printing densities between "light" and "dark" to be reproduced. Whereas the raster signal effects an oscillating lifting

20   motion of the engraving stylus for engraving the cups arranged in the printing raster, the image signal values determine the cut depths of the engraved cups in conformity with the tonal values to be reproduced.

        For magazine printing, a plurality of strip-shaped cylinder regions called engraving lanes that lie axially next to one another must be simultaneously

25   engraved with a respective engraving element on a printing cylinder or[, respectively,] on the printing cylinders of a color set that are successively engraved in one engraving machine or, on the other hand, simultaneously engraved in a plurality of engraving machines. For example, the various printed pages of a print job are produced in the individual engraving lanes. The

engraving control signals for the individual engraving elements are thereby generated in separate electronic units, referred to as engraving channels.

A pre-requisite for a good reproduction quality is that the engraved printing densities in the individual engraving lanes coincide, i.e. that what is referred to as a lane equality is achieved. Even when the individual engraving

5   channels are electrically balanced, the engraving styli often exhibit different degrees of wear. The result is that cups having different geometrical dimensions or volumes are engraved in the individual engraving lanes, as a result of which disturbing differences in printing density occur in the engraving lanes. Worn engraving styli also generate cups with a rougher inside surface, as a result of

10   which the ink acceptance behavior in the printing machine and, thus, the printing density are varied. Different printing densities in the engraving lanes can also be attributed to influences in the printing machine, for example when the pressing power between printing cylinder and cooperating printing cylinder varies in the axial direction or when the doctor blade with which excess ink is stripped

15   off does not lie against the printing cylinder with the same tightness everywhere.

In order to achieve identical printing densities in the engraving lanes, engraving styli having the same degree of wear are currently sought insofar as possible for the engraving. As a precautionary measure, the engraving styli are also replaced by new engraving styli after a specific number of operating hours,

20   this being relatively involved and expensive.

Even when new engraving styli are employed, density differences due to engraved areas that differ in size can soon arise in the individual engraving lanes as can, connected therewith, wear of the engraving styli that occurs with differing repetity. Different engraving properties such as the hardness of the material and

25   the cutting behavior of the engraving stylus in the material - whereby the material is generally copper - can, for example, arise due to a non-uniform galvanization of the printing cylinder.

The differences in printing density in the engraving lanes can occur with respect to one printing density value or with respect to a printing density range

30   and can differ in size for each engraving lane. Additionally, the engraving

properties can change at the circumference of the printing cylinder, so that differences in printing density can also occur within an engraving lane.

For matching such differences in printing density, the engraved printing cylinder is currently chemically post-processed in practice in a time-consuming and work-intensive work process, particularly given high quality commands made of the printed products printed with the cylinder.

SUMMARY OF THE INVENTION

It is an object of the invention to improve upon engraving of printing cylinders in an electronic engraving machine, wherein at least two engraving lanes are engraved with a respectively allocated engraving element on a printing cylinder, such that disturbing differences in printing density are automatically compensated in the engraving lanes.

In accordance with a method of the invention for engraving printing cylinders in an electronic engraving machine, printing densities in the individual engraving lanes are matched by engraving cups in the printing lanes with which the prescribed characteristic rated printing densities are to be achieved. The actual printing densities achieved are identified by measurement after the printing. A corrected lane calibration is derived for the respective engraving lane from deviations between the rated printing densities and the actual printing densities. The allocated, corrected lane calibration is applied in the engraving lanes.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the relationship between signal value and printing density for three characteristic rated density values;

Fig. 2 shows the relationship between the rated density values and the rated transverse diagonals corresponding to them (standard calibration function);

Fig. 3 illustrates the residual deviations of the actual printing densities for three characteristic tonal values and for the individual engraving lanes;

Fig. 4 shows the residual deviations between actual printing densities and rated printing densities in an engraving lane;

Fig. 5 illustrates the correction function $\Delta Q = f(Q)$ for an engraving lane;

Fig. 6 shows the corrected calibration function for an engraving lane;

Fig. 7 illustrates the correction of the signal values;

Fig. 8 shows the allocation between signal values and corrected signal values; and

5   Fig. 9 illustrates the variation of the geometry values over time.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the preferred embodiment illustrated in the drawings and specific language will be used to describe the same. It will

10   nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and/or method, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur now or in the future to one skilled in the art to which the invention relates.

15   According to the prior art, rated printed densities D_{rated} for characteristic tonal values of a test wedge to be engraved are prescribed in every engraving lane of a printing cylinder for calibrating the printing density D. The test wedge, for example, comprises three characteristic tonal values having the rated printed densities $D_{rated} = (0.25; 0.5; 0.8)$. The signal values S = (161; 80; 1) with which

20   the engraving system is driven belong thereto. Fig. 1 shows the relationship between the signal values S and the printing densities D. A test wedge with the prescribed signal values S is engraved in each engraving lane on a printing cylinder. The engraving of the test wedges on the printing cylinder can occur separately from or simultaneously with the engraving of the actual printing form

25   in cylinder regions lying outside the printing form. Likewise, regions of the production engraving can also be utilized for the calibration when they contain the characteristic tonal values. After the engraving of the printing cylinder, the engraved printing cylinder is proof printed in a printing machine. In the proof printing, the actual printing densities D_{actual} achieved for the test wedges engraved

30   in the individual engraving lanes are measured with a suitable density measuring

instrument, and the deviations from the rated printed densities D_{rated} are identified (Fig. 1). These deviations are compensated in the individual engraving lanes with a suitable calibration of the transfer function of the engraving systems, for example by setting the signal gain and the activation point of the amplification of the engraving systems.

5   Since new proof prints cannot be constantly made for reasons of expense during the setting of the engraving systems in order to identify the actual printing densities D_{actual} that have already been achieved, the actual printing densities D_{actual} are derived from the measurement of geometry values of the engraved test wedge cups. Rated geometry values that define the desired shape and size of

10   the cups to be engraved correspond to the prescribed rated density values D_{rated}. Geometry values can be the longitudinal diagonals, the transverse diagonals, the areas or volumes of the cups dependent on which measuring method is employed for measuring the engraved cup size. Preferably, the transverse diagonals of the cups are utilized since they are simple to measure. Fig. 2 shows

15   the relationship between the rated printing densities D_{rated} and the rated transverse diagonals Q_{rated} of the cups corresponding to them. Given the standard collaboration function, the rated transverse diagonals Q_{rated} = (30 µm; ;100 µm; 170µm) correspond to the characteristic rated printing densities D_{rated} = (0.25; 0.5; 0.8).

20   The rated printing densities D_{rated} are converted into the corresponding signal values for driving the engraving amplifiers allocated to the individual engraving lanes, the engraving control signals for controlling the engraving styli of the engraving elements being generated in the engraving amplifiers. The actual geometry values of the cups that are achieved are measured in every

25   engraved test wedge of an engraving lane. The measurement of the geometry values can occur with the assistance of a measuring microscope or in a video image registered by a video camera. The engraving systems of the individual engraving lanes are set such that the actual geometry values reach the rated geometry values that correspond to the prescribed rated printing densities.

A standard calibration function between the rated printing densities D_{rated} and, for example, the rated transverse diagonals Q_{rated} corresponding to them (Fig. 2) is employed for this collaboration according to the prior art, the rated transverse diagonals Q_{rated} having been determined for a new engraving stylus and having been defined by averaging over a plurality of engraved test wedges and proof printings. The result thereof is that the influences differing from engraving lane to engraving lane that were initially explained such as degree of wear of the engraving stylus, ink acceptance behavior, hardness of the material, cutting behavior, etc., are not taken into consideration in the collaboration. After the collaboration, the actual printing densities D_{actual} in the individual engraving lanes can therefore still deviate from the rated printing densities D_{rated}. Fig. 3 shows these residual deviations of the actual print densities D_{actual} for the three characteristic tonal values and for the individual engraving lanes.

In the method disclosed, of the preferred embodiment, correction values are derived from the residual deviations for the individual engraving lanes, said correction values being taken into consideration in the next engraving of a printing cylinder with the same engraving system in the respective engraving lane in the collaboration, so that the calibration takes the lane-individual influences and differences into consideration, and, thus, the rated printed densities are achieved more dependably and more exactly in all engraving lanes. The method is explained below with reference to the example of engraving lane number 1. For this purpose, Fig. 4 shows the rated printing densities D_{rated} and the actual printing densities D_{actual} achieved in this engraving lane after the standard calibration dependent on the transverse diagonals Q. The residual deviations between rated printing densities D_{rated} and actual printing densities D_{actual} has been entered highly exaggerated in Fig. 4 in order to be able to clearly present a preferred embodiment of the method. According to the standard calibration, a transverse diagonal of Q_{rated} = 100µm is set (Point A) for the value D_{rated} = 0.5 of the rated printing density. The actual printing density D_{actual} achieved therewith is higher by the residual deviation ΔD (Point B). Corresponding deviations derive for the other characteristic tonal values for which the transverse diagonals Q_{rated} = 30µm or,

respectively, Q_{rated} = 170μm had been set in the engraving. When the points of the actual printing densities D_{actual} that are achieved for the three characters to tonal values are connected in this diagram, then the broken-line curve of the actual printing density is obtained. According to the curve of the actual printing densities, the rated printing density value D_{rated} = 0.5 is achieved in Point C, i.e.

5   with a transverse diagonal deviating by ΔQ = -16μm. Thus when the corrected transverse diagonal Q_{corr} = 100μm + ΔQ = 84μm is set for the rated printing density value D_{rated} = 0.5 in the next engraving in this engraving lane, the rated printing density value D_{rated} is exactly achieved or is at least achieved with far greater precision. Based on the same consideration, correction values ΔQ for

10   the various values of the transverse diagonals can be derived from the comparison of the curves for the rated printing density D_{rated} and actual printing density D_{actual}. An individual correction function ΔQ = f(Q) ultimately derives therefrom for each engraving lane, this being shown in Fig. 5 for the example under consideration. This correction function can also be immediately taken into

15   consideration in the standard calibration function according to Fig. 2 as well, as a result of which a lane calibration function is obtained that is employed in the next production engraving for this engraving lane (Fig. 6).

The actual printing densities D_{actual} achieved with the cups engraved in the test wedges and the potentially remaining residual deviations relative to the rated

20   printing densities D_{rated} are identified in (Fig. 3) after one or more renewed production engravings of a printing cylinder with the same engraving systems in the individual engraving lanes or are also identified at certain regular time intervals. In the way set forth above, an improved lane calibration function is calculated therefrom (Fig. 6), this then being employed in the following production

25   engravings. Expediently, the calculation of a new lane calibration occurs when the residual deviations between the rated printing densities D_{rated} and the actual printing densities D_{actual} have exceeded a prescribed tolerance limit. The calibration of the engraving lanes thus occurs in a process of "self-learning" wherein the settings of the engraving amplifiers in the individual engraving

30   channels are continuously optimally adapted to the varying technical boundary

conditions such as, for example, differing degrees of wear of the engraving styli employed.

The calibration method preferred embodiment for density matching of the engraved lanes has been explained with reference to the example of setting the engraving channels with the transverse diagonals of the engraved cups. The method can be implemented in the same way when the transverse diagonal is replaced by some other geometry value of the engraved test wedge cups, for example the longitudinal diagonals, the area or the volume of the cups. Analogous to the relationship of Fig. 2, a standard calibration function is employed for this purpose that places the geometry value employed into relationship with the rated printing densities D_{rated}. After setting the rated geometry values according to this standard calibration function, the actual printing densities D_{actual} of the engraved test wedges are measured, and individual corrections of the geometry value employed are derived therefrom for the individual engraving lanes in order to erect a lane calibration function (analogous to Fig. 4 and Fig. 5).

An improved precision of the calibration method example provided can be achieved when the setting of the geometry value employed occurs not only for the three characteristic rated printing densities but also occurs for further intermediate stages, for example for tonal values in a graduation of 10% between light and dark.

In another embodiment of the calibration method, the signal values S with which the engraving channels are driven are individually corrected for every individual lane instead of the geometry value employed. This is illustrated in Fig. 7 that shows the relationship between the signal values S and the printing densities D (see Fig. 1). The rated printing densities D_{rated} and the actual printing densities D_{actual} achieved in a specific engraving lane following the standard calibration are entered dependent on the drive signal values S. A signal value S = 80 (Point E) was applied for driving for the value D_{rated} = 0.5 of the rated printing density. The actual printing density thus achieved is higher by the residual deviation ΔD (Point F). Corresponding deviations derived for the other

characteristics tonal values for which the signal values $S = 1$ or, respectively, S = 161 had been applied in the engraving. When the points of the actual printing densities D_{actual} that were achieved for the three characteristic tonal values are connected in this diagram, then the broken-line curve of the actual printing densities is obtained. According to the curve of the actual printing densities, the rated printing density value $D_{rated} = 0.5$ is reached in the Point G, i.e. with a signal value deviating by $\Delta S = 15$. Thus when the corrected signal value $S_{corr} = 80 + \Delta S$ = 95 is applied in the next engraving in this engraving lane for the rated printing density value $D_{rated} = 0.5$, the rated printing density value D_{rated} is exactly achieved or is at least achieved with far greater precision. Based on the same consideration, correction values ΔS for all signal values S can be derived from the comparison of the curves for the rated printing density D_{rated} and the actual printing density D_{actual}. An individual correction function $S_{corr} = g(S)$ for the signal values ultimately derives therefrom for each engraving lane, this being shown in Fig. 8 for the example under consideration. This correction function can, for example, be realized by a table memory in each engraving channel, a corrected signal value S_{corr} being allocated to every input signal value S therewith. In this embodiment of the calibration method, care must be exercised to see that the actual printing density D_{actual} for the smallest signal values S has values that are higher than or equal to the rated printing density D_{rated}, since negative signal values would otherwise have to be generated by the calibration. This condition can be assured, for example, by an enhanced pigmentation of the ink, whereby the pigmentation of the ink must be enhanced to such an extent that the above condition is met in all lanes.

In another development of the calibration method, the time variation of the residual deviations between actual printing density D_{actual} and rated printing density D_{rated} in the individual engraving lanes is additionally taken into consideration in order to make a prediction about the anticipated residual deviations and, thus, about the anticipated changes in the lane calibration function. One reason for the time variation is the progressive wear of the engraving stylus with age or[, respectively,] the frequency with which the

engraving stylus is used. Different degrees of wear of the engraving styli can be caused in that areas of different size were previously engraved in the engraving lanes and/or the engraving lanes exhibit different engraving properties that, for example, are to be attributed to a non-uniform galvanization of the printing cylinder.

5   Fig. 9 shows the time dependency for a lane of the transverse diagonals Q for the three characteristic tonal values to be set in the lane calibration according to the method. It is assumed that the transverse diagonals Q to be set were already redetermined at the respective time interval T for two matching periods of the lane calibration. A prediction for the variation of the transverse

10   diagonals Q to be set in the next engravings can then be made (broken-line part of the curves) from the slope that the curves have been reached at time 2T, the exact values being in turn determined from the measurement of the actual printing densities D_{actual} by time 3T. As a result of this extrapolation, the measurement and matching of the lane calibration need not be implemented as

15   often. Instead of being entered dependent on the time, the variation of the geometry values relevant for the calibration can also be entered, for example, dependent on the frequency with which the engraving styli are used in order to derive the prediction about the setting values for the next engravings. The frequency of the use can, for example, be measured in that the cumulated

20   number of engraved cups is summed up in a counter that is present in every engraving channel.   Alternatively, this number can also be determined in the control software and stored.

           In an advantageous embodiment, the measurements of the actual printing densities and the geometry values that are set are undertaken by automatic

25   measuring devices.   It is also advantageous to store and administer the measured values and the identified setting values for the individual lane calibrations as well as the time dependencies and development tendencies in a central computer, so that the density match in between the individual engraving lanes automatically sequence it and is also automatically adapted to the change

30   in technical boundary conditions over a longer time.

While a preferred embodiment has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention both now or in the future

5   are desired to be protected.

BOX PCT

IN THE UNITED STATES ELECTED OFFICE

OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

UNDER THE PATENT COOPERATION TREATY

5   **DRAWING CORRECTION LETTER**

APPLICANT: Ernst-Rudolf Gottfried Weidlich

                                 DOCKET NO: P02,0000

SERIAL NO: GROUP ART UNIT:

                                 EXAMINER:

10   INTERNATIONAL APPLICATION NO: PCT/DE00/003581

INTERNATIONAL FILING DATE: 12 October 2000

INVENTION: **"METHOD FOR ENGRAVING PRINTING CYLINDERS"**

Assistant Commissioner for Patents

     Washington, D.C. 20231

15 Sir:

     Please amend Fig. 1 as indicated in red on the attached drawing copy. Attached is the Formal Drawing for Fig. 1 showing the corrections.

     Respectfully submitted,

20

                                      (Reg.No. 27,841

Brett A. Valiquet

SCHIFF HARDIN & WAITE

Patent Department

25 6600 Sears Tower

Chicago, Illinois 60606

(312) 258-5786

Attorneys for Applicant

CUSTOMER NO. 26574
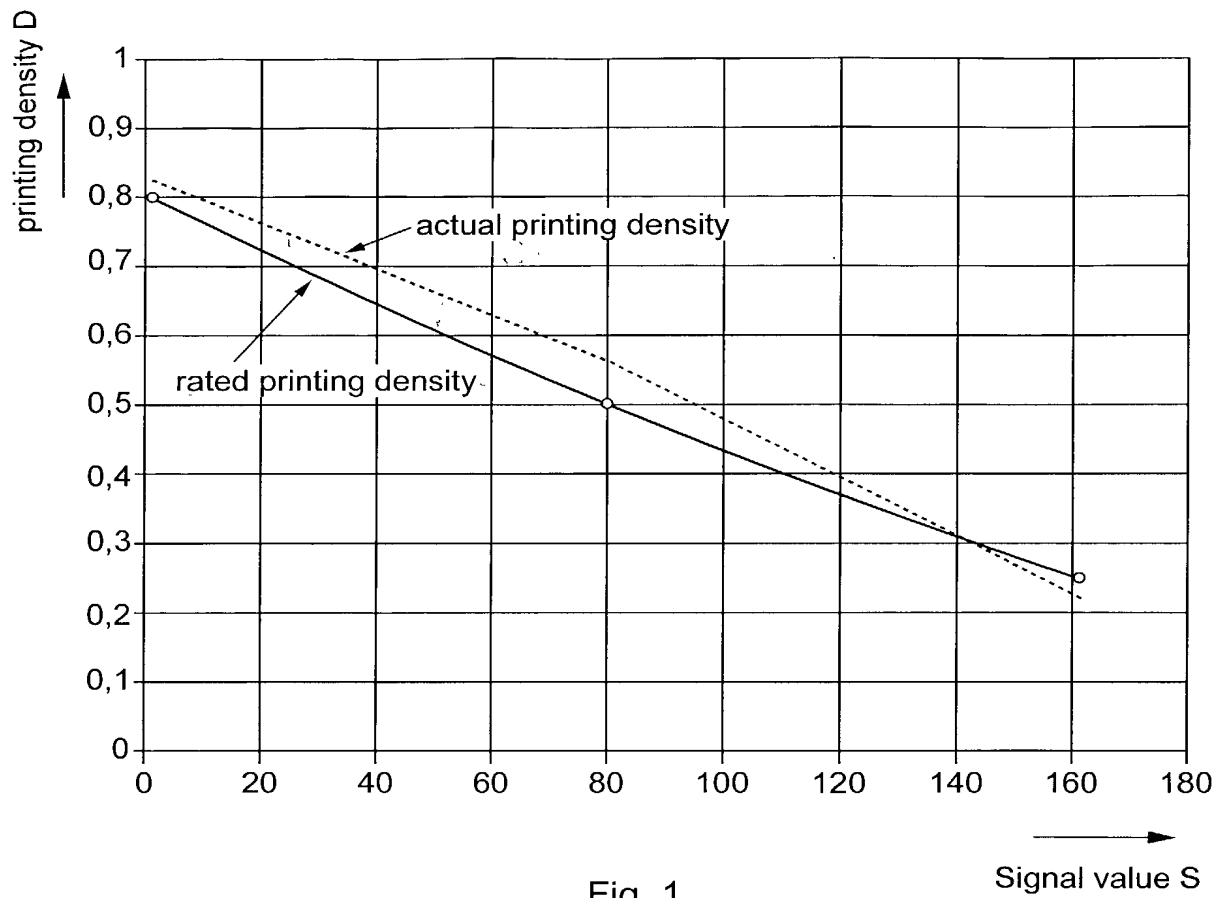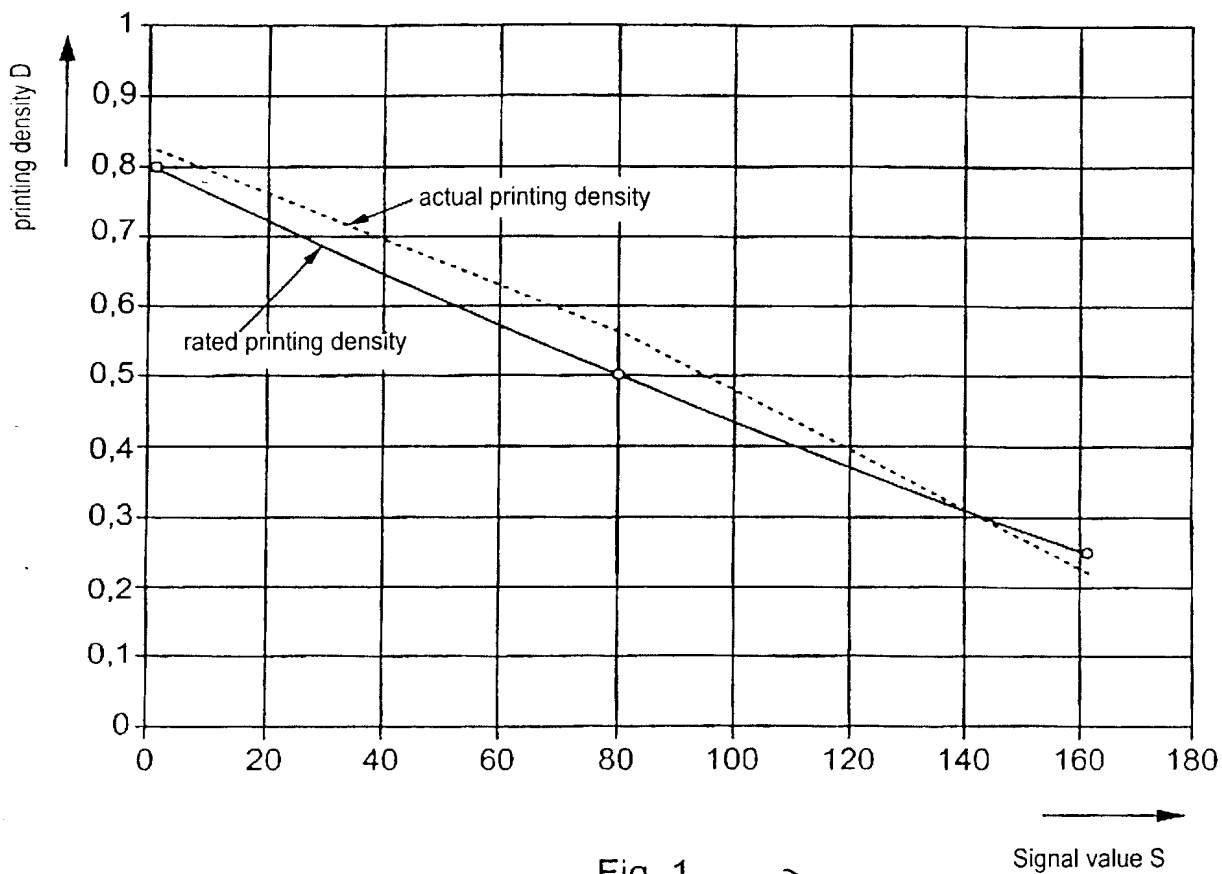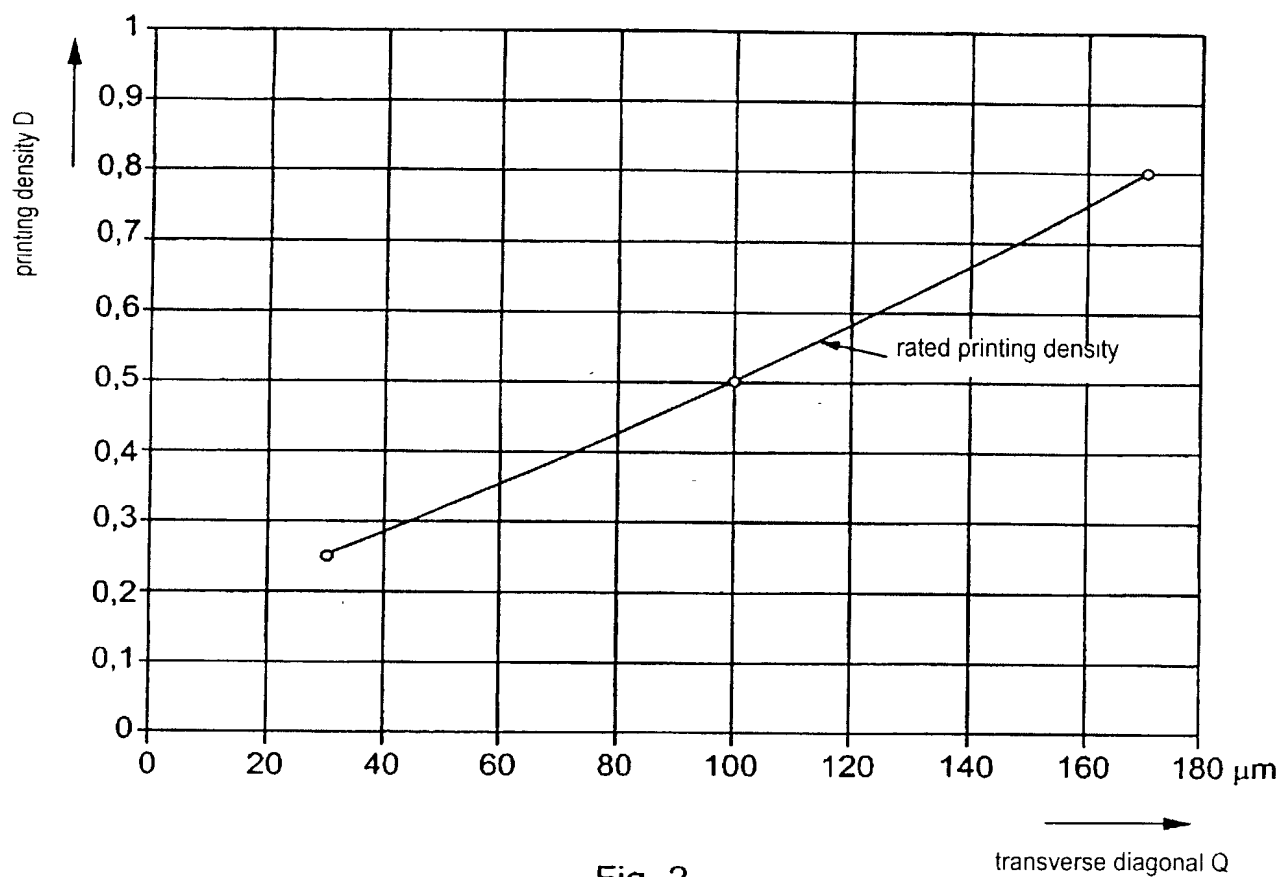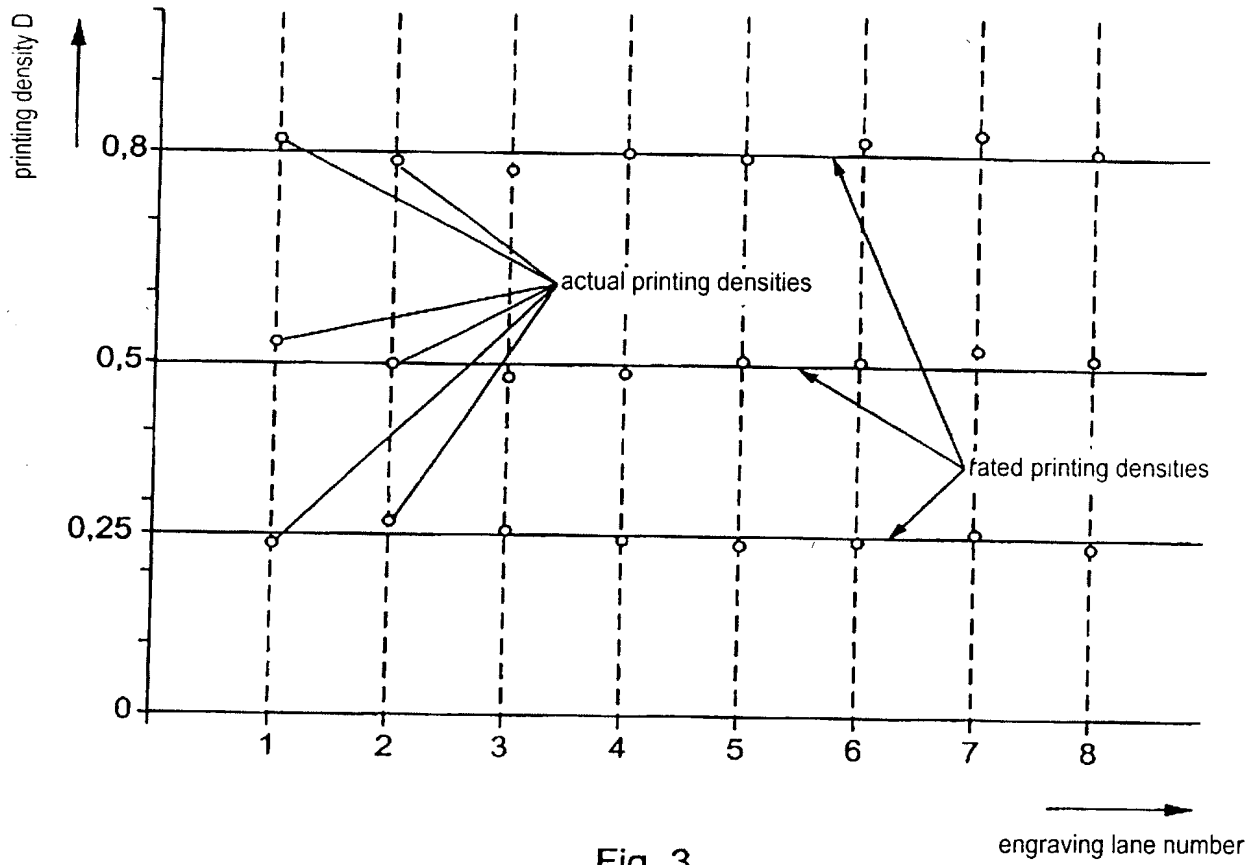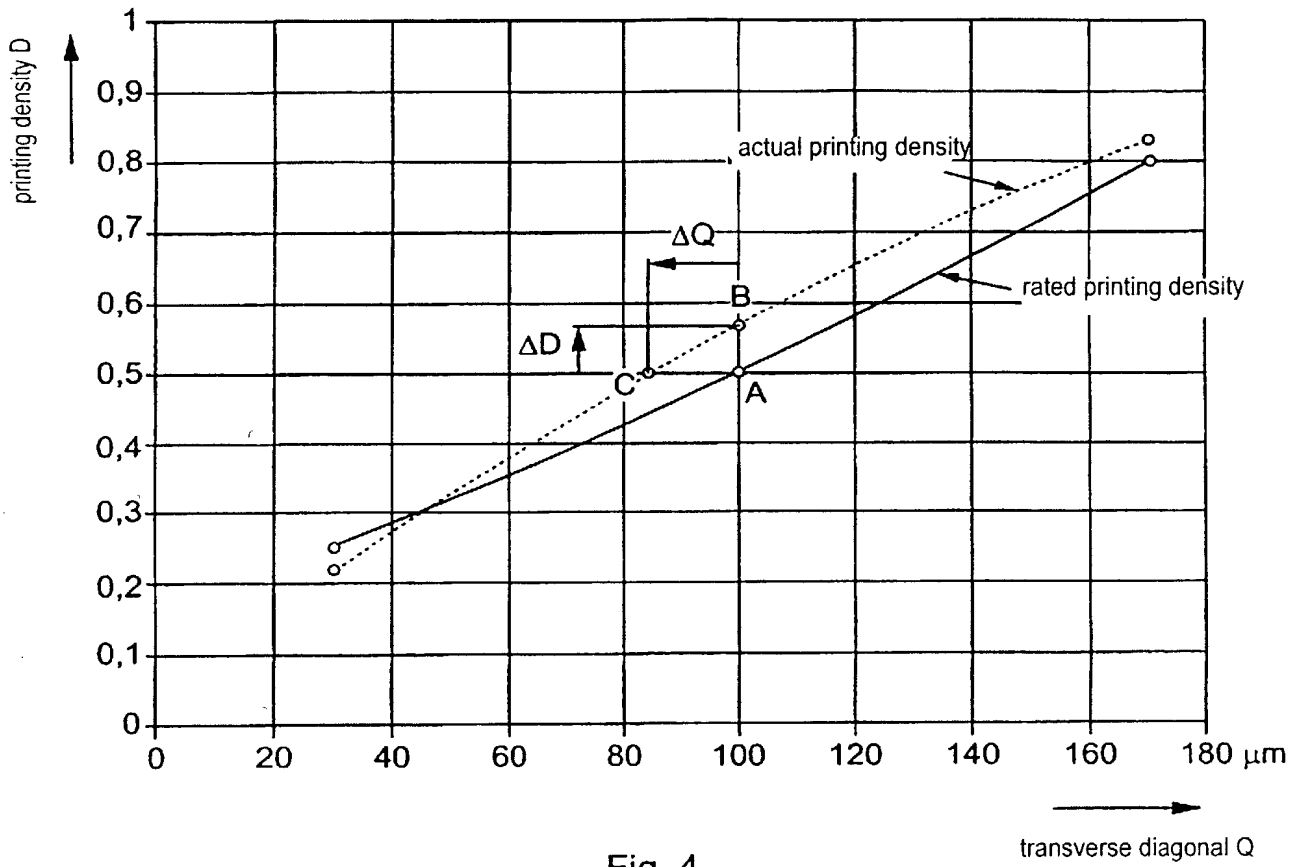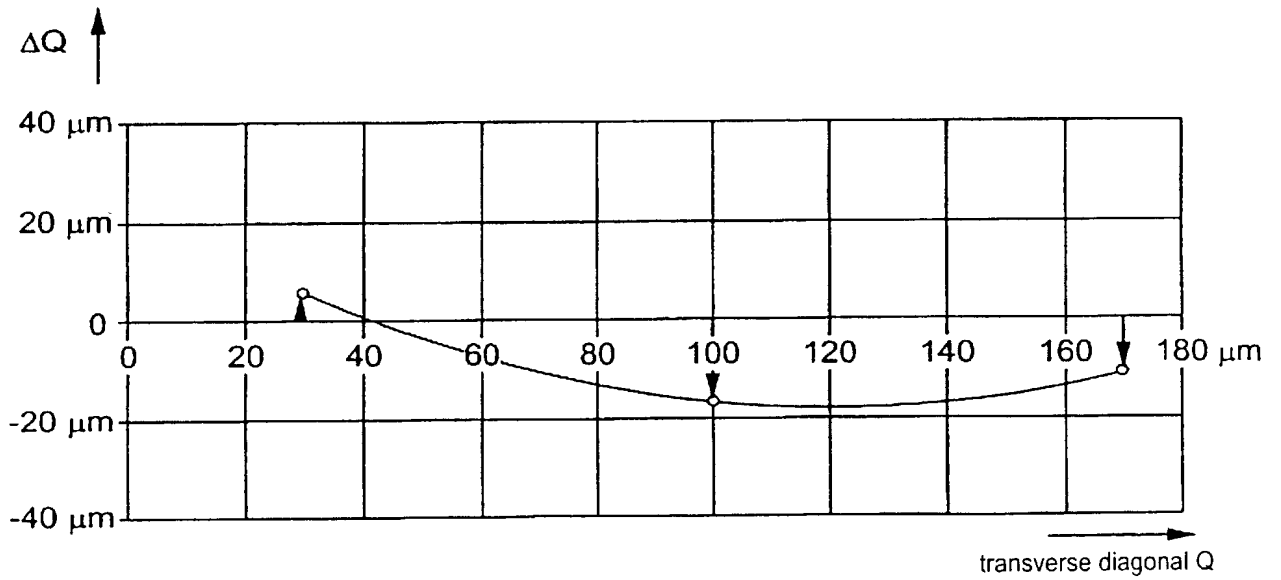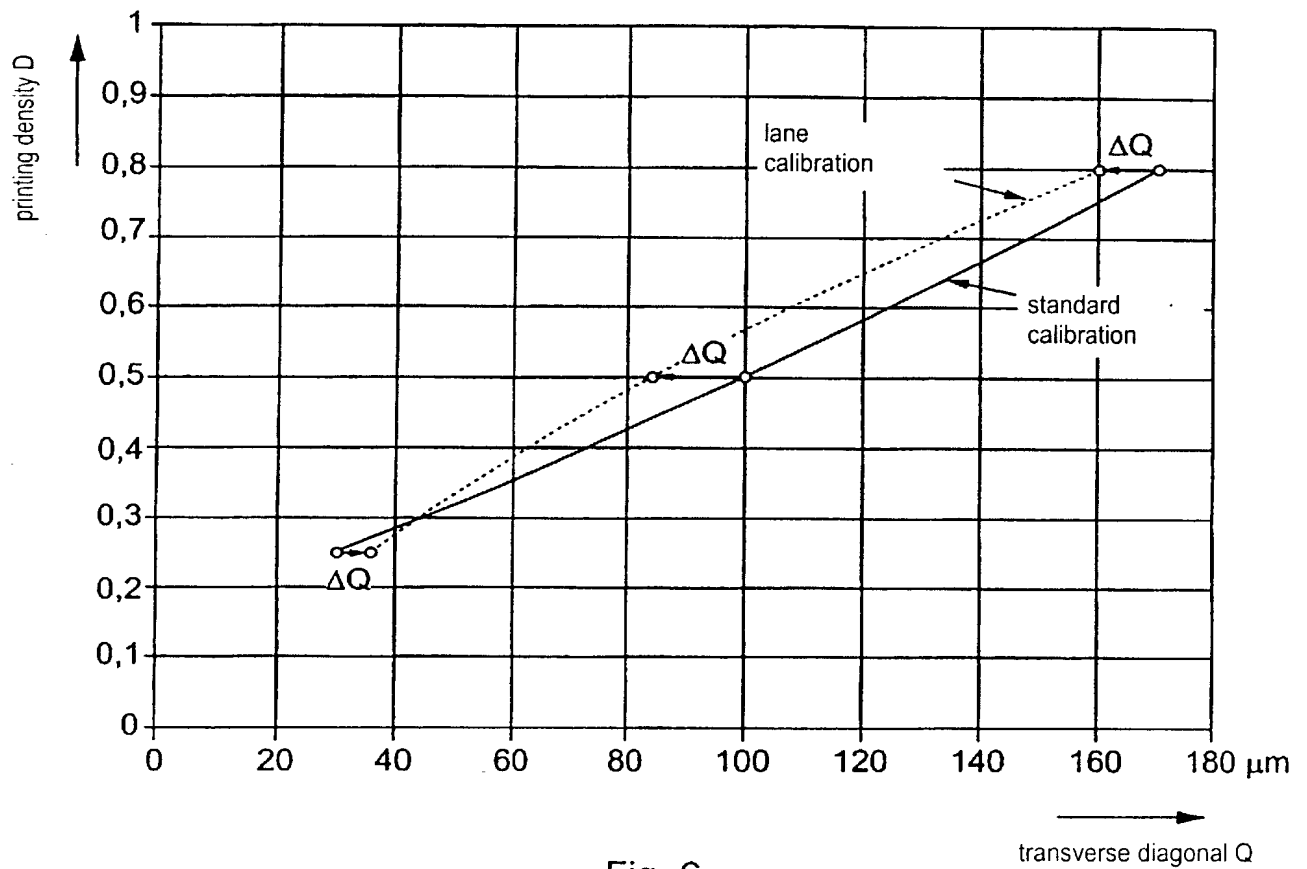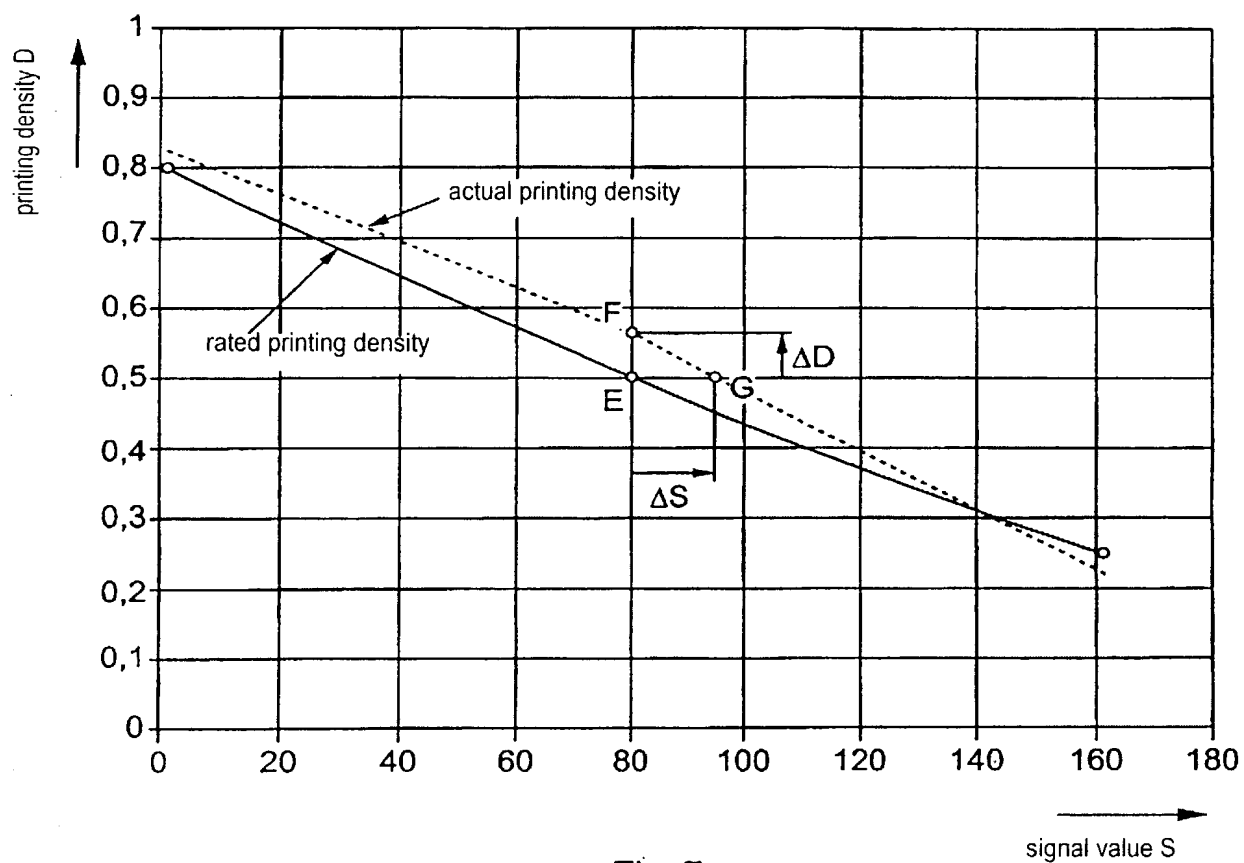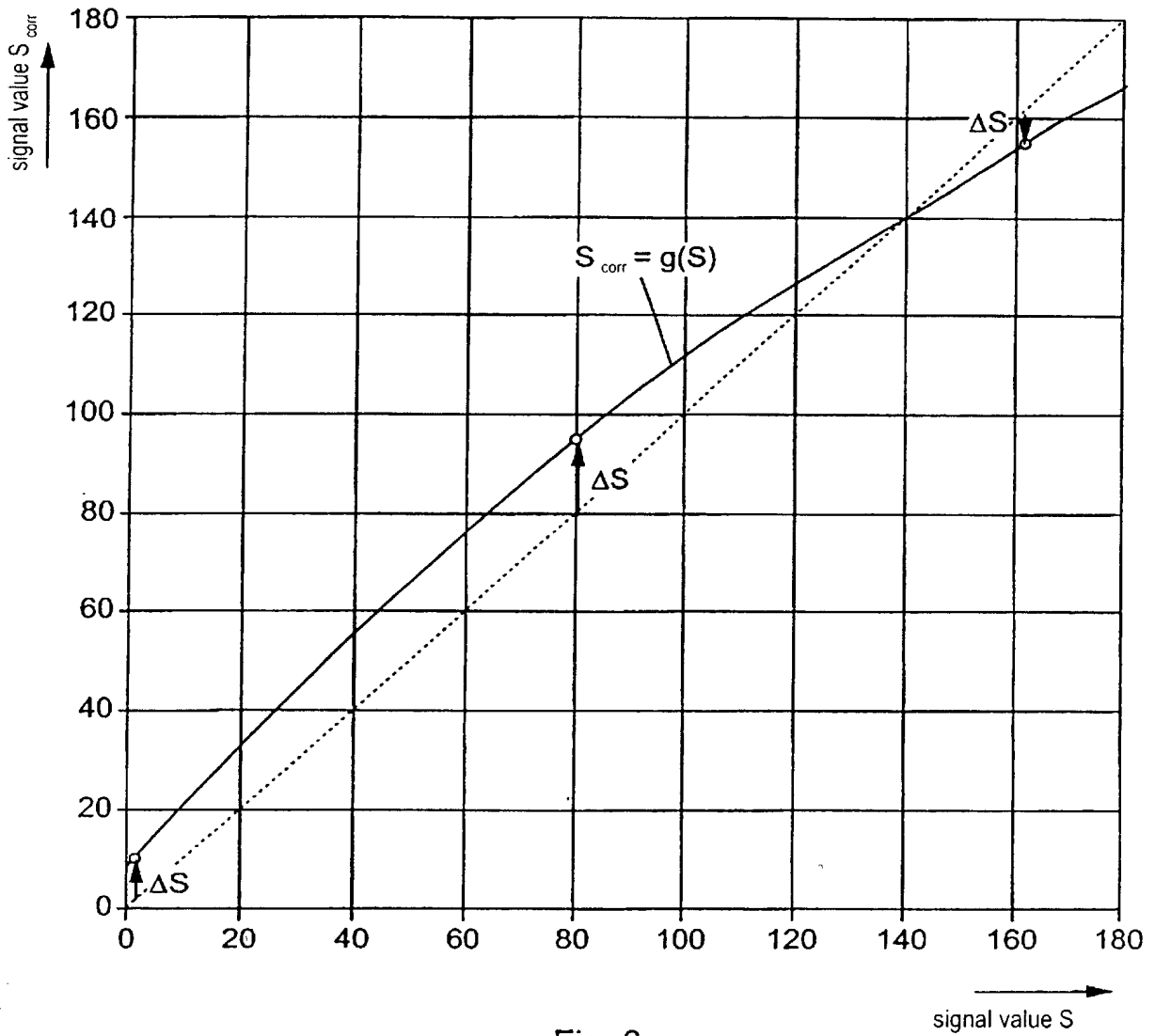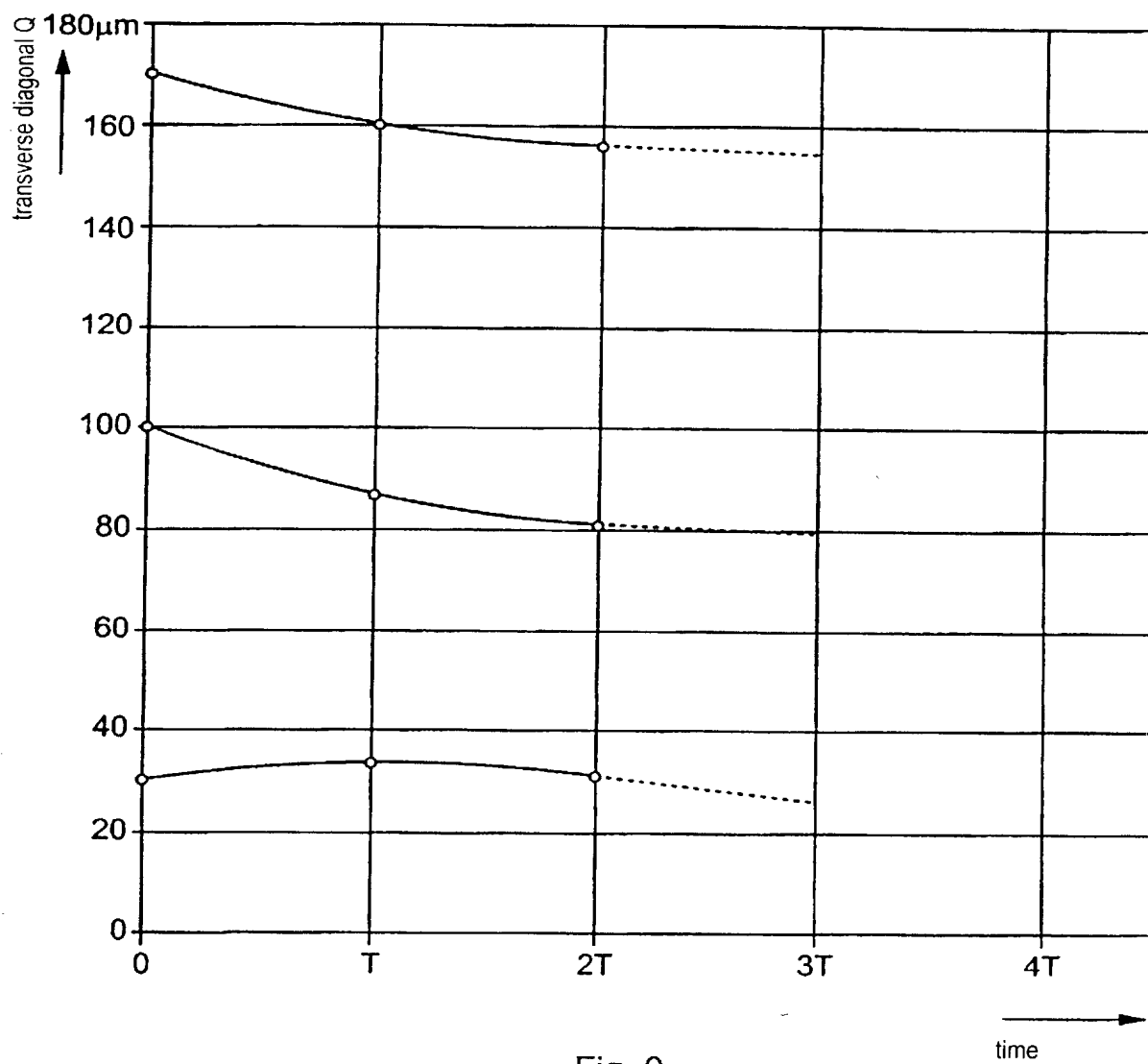
Fig. 1

(Prior Art)

Fig. 1

(PRIOR ART)

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

1

METHOD FOR ENGRAVING PRINTING CYLINDERS

The invention is in the field of electronic reproduction technology and is directed to a method for engraving printing cylinders in an electronic engraving machine, whereby at least two engraving lanes that lie next to one another in axial

5   direction are engraved on a printing cylinder with a respective engraving element.

DE-C-25 087 34 already discloses an electronic engraving machine for engraving printing cylinders with an engraving element. The engraving element, having an engraving stylus controlled by an engraving control signal as cutting tool, for example in the form of a diamond, moves in axial direction along a rotating

10   printing cylinder. The engraving stylus cuts a sequence of cups arranged in a printing raster into the generated surface of the printing cylinder. The engraving control signal is formed in an engraving amplifier by superimposition of a periodic raster signal, also referred to as vibration, with image signal values that represent the printing densities between "light" and "dark" to be reproduced. Whereas the raster signal

15   effects an oscillating lifting motion of the engraving stylus for engraving the cups arranged in the printing raster, the image signal values determine the cut depths of the engraved cups in conformity with the tonal values to be reproduced.

For magazine printing, a plurality of strip-shaped cylinder regions called engraving lanes that lie axially next to one another must be simultaneously engraved

20   with a respective engraving element on a printing cylinder or, respectively, on the printing cylinders of a color set that are successively engraved in one engraving machine or, on the other hand, simultaneously engraved in a plurality of engraving machines. For example, the various printed pages of a print job are produced in the individual engraving lanes. The engraving control signals for the individual

25   engraving elements are thereby generated in separate electronic units, referred to as engraving channels.

A pre-requisite for a good reproduction quality is that the engraved printing densities in the individual engraving lanes coincide, i.e. that what is referred to as a lane equality is achieved.   Even when the individual engraving channels are

30   electrically balanced, the engraving styli often exhibit different degrees of wear. The

result is that cups having different geometrical dimensions or, respectively, volumes are engraved in the individual engraving lanes, as a result whereof disturbing differences in printing density occur in the engraving lanes. Worn engraving styli also generate cups with a rougher inside surface, as a result whereof the ink

5   acceptance behavior in the printing machine and, thus, the printing density are varied. Different printing densities in the engraving lanes can also be attributed to influences in the printing machine, for example when the pressing power between printing cylinder and cooperating printing cylinder varies in axial direction or when the doctor blade with which excess ink is stripped off does not lie against the printing cylinder

10   with the same tightness everywhere.

In order to achieve identical printing densities in the engraving lanes, engraving styli having the same degree of wear are currently sought insofar as possible for the engraving. As a precautionary measure, the engraving styli are also replaced by new engraving styli after a specific number of operating hours, this being

15   relatively involved and expensive.

Even when new engraving styli are employed, density differences due to engraved areas that differ in size can soon arise in the individual engraving lanes as can, connected therewith, wear of the engraving styli that occurs differing in repetity. Different engraving properties such as the hardness of the material and the cutting

20   behavior of the engraving stylus in the material - whereby the material is generally copper - can, for example, arise due to a non-uniform galvanization of the printing cylinder.

The differences in printing density in the engraving lanes can occur with respect to one printing density value or with respect to a printing density range and can

25   differ in size for each engraving lane. Additionally, the engraving properties can change at the circumference of the printing cylinder, so that differences in printing density can also occur within an engraving lane.

For matching such differences in printing density, the engraved printing cylinder is currently chemically post-processed in practice in a time-consuming and

30   work-intensive work process, particularly given high quality commands made of the printed products printed with the cylinder.

The invention is therefore based on the object of improving a method for engraving printing cylinders in an electronic engraving machine, whereby at least two engraving lanes that lie side-by-side in axial direction are engraved with a respectively allocated engraving element on a printing cylinder, such that disturbing differences in

5   printing density are automatically compensated in the engraving lanes.

This object is achieved by the features of claim 1. Advantageous developments are recited in the subclaims. The invention is described in greater detail below on the basis of Figures 1 through 9. Shown are:

Fig. 1   the relationship between signal value and printing density for three

10   characteristic rated density values;

Fig. 2   the relationship between the rated density values and the rated transverse diagonals corresponding to them (standard calibration function);

Fig. 3   the residual deviations of the actual printing densities for three characteristic tonal values and for the individual engraving lanes;

15   Fig. 4   the residual deviations between actual printing densities and rated printing densities in an engraving lane;

Fig. 5   the correction function $\Delta Q = f(Q)$ for an engraving lane;

Fig. 6   the corrected calibration function for an engraving lane;

Fig. 7   the correction of the signal values;

20   Fig. 8   the allocation between signal values and corrected signal values; and

Fig. 9   the variation of the geometry values over time.

According to the prior art, rated printed densities D_{rated} for characteristic tonal values of a test wedge to be engraved are prescribed in every engraving lane of a printing cylinder for calibrating the printing density D. The test wedge, for example,

25   comprises three characteristic tonal values having the rated printed densities $D_{rated} =$ (0.25; 0.5; 0.8). The signal values $S = (161; 80; 1)$ with which the engraving system is driven belong thereto. Fig. 1 shows the relationship between the signal values S and the printing densities D. A test wedge with the prescribed signal values S is engraved in each engraving lane on a printing cylinder. The engraving of the test wedges on the

30   printing cylinder can ensue separately from or simultaneously with the engraving of the actual printing form in cylinder regions lying outside the printing form. Likewise,

regions of the production engraving can also be utilized for the calibration when they contain the characteristic tonal values. After the engraving of the printing cylinder, the engraved printing cylinder is proof printed in a printing machine. In the proof printing, the actual printing densities D_{actual} achieved for the test wedges engraved in the

5 individual engraving lanes are measured with a suitable density measuring instrument, and the deviations from the rated printed densities D_{rated} are identified (Fig. 1). These deviations are compensated in the individual engraving lanes with a suitable calibration of the transfer function of the engraving systems, for example by setting the signal gain and the activation point of the amplification of the engraving systems.

10 Since new proof prints cannot be constantly made for reasons of outlay during the setting of the engraving systems in order to identify the actual printing densities D_{actual} that have already been achieved, the actual printing densities D_{actual} are derived from the measurement of geometry values of the engraved test wedge cups. Rated geometry values that define the desired shape and size of the cups to be engraved

15 correspond to the prescribed rated density values D_{rated}. Geometry values can be the longitudinal diagonals, the transverse diagonals, the areas or volumes of the cups dependent on which measuring method is employed for measuring the engraved cup size. Preferably, the transverse diagonals of the cups are utilized since they are simple to measure. Fig. 2 shows the relationship between the rated printing densities D_{rated} and

20 the rated transverse diagonals Q_{rated} of the cups corresponding to them. Given the standard collaboration function, the rated transverse diagonals Q_{rated} = (30 µm; ;100 µm; 170µm) correspond to the characteristic rated printing densities D_{rated} = (0.25; 0.5; 0.8).

The rated printing densities D_{rated} are converted into the corresponding signal

25 values for driving the engraving amplifiers allocated to the individual engraving lanes, the engraving control signals for controlling the engraving styli of the engraving elements being generated in said engraving amplifiers. The actual geometry values of the cups that are achieved are measured in every engraved test wedge of an engraving lane. The measurement of the geometry values can ensue with the assistance of a

30 measuring microscope or in a video image registered by a video camera. The engraving systems of the individual engraving lanes are set such that the actual

geometry values reach the rated geometry values that correspond to the prescribed rated printing densities.

A standard calibration function between the rated printing densities D_{rated} and, for example, the rated transverse diagonals Q_{rated} corresponding to them (Fig. 2) is

5   employed for this collaboration according to the prior art, said rated transverse diagonals Q_{rated} having been determined for a new engraving stylus and having been defined by averaging over a plurality of engraved test wedges and proof printings. The result thereof is that the influences differing from engraving lane to engraving lane that were initially explained such as degree of wear of the engraving stylus, ink acceptance

10   behavior, hardness of the material, cutting behavior, etc., are not taken into consideration in the collaboration. After the collaboration, the actual printing densities D_{actual} in the individual engraving lanes can therefore still deviate from the rated printing densities D_{rated}. Fig. 3 shows these residual deviations of the actual print densities D_{actual} for the three characteristic tonal values and for the individual engraving

15   lanes.

According to the inventive method, correction values are derived from the residual deviations for the individual engraving lanes, said correction values being taken into consideration in the next engraving of a printing cylinder with the same engraving system in the respective engraving lane in the collaboration, so that the

20   calibration takes the lane-individual influences and differences into consideration, and, thus, the rated printed densities are achieved more dependably and more exactly in all engraving lanes. The method is explained below with reference to the example of engraving lane number 1. To this end, Fig. 4 shows the rated printing densities D_{rated} and the actual printing densities D_{actual} achieved in this engraving lane after the

25   standard calibration dependent on the transverse diagonals Q. The residual deviations between rated printing densities D_{rated} and actual printing densities D_{actual} has been entered highly exaggerated in Fig. 4 in order to be able to clearly present the inventive method. According to the standard calibration, a transverse diagonal of $Q_{rated} = 100 \mu m$ is set (Point A) for the value $D_{rated} = 0.5$ of the rated printing density. The actual

30   printing density D_{actual} achieved therewith is higher by the residual deviation ΔD (Point B). Corresponding deviations derive for the other characteristic tonal values for which

the transverse diagonals $Q_{rated} = 30\mu m$ or, respectively, $Q_{rated} = 170\mu m$ had been set in the engraving. When the points of the actual printing densities D_{actual} that are achieved for the three characters to tonal values are connected in this diagram, then the broken-line curve of the actual printing density is obtained. According to the curve of the

5 actual printing densities, the rated printing density value $D_{rated} = 0.5$ is achieved in Point C, i.e. with a transverse diagonal deviating by $\Delta Q = -16\mu m$. When, thus, the corrected transverse diagonal $Q_{corr} = 100\mu m + \Delta Q = 84\mu m$ is set for the rated printing density value $D_{rated} = 0.5$ in the next engraving in this engraving lane, the rated printing density value D_{rated} is exactly achieved or is at least achieved with far greater precision.

10 Based on the same consideration, correction values ΔQ for the various values of the transverse diagonals can be derived from the comparison of the curves for the rated printing density D_{rated} and actual printing density D_{actual}. An individual correction function $\Delta Q = f(Q)$ ultimately derives therefrom for each engraving lane, this being shown in Fig. 5 for the example under consideration. This correction function can also

15 be immediately taken into consideration in the standard calibration function according to Fig. 2 as well, as a result whereof a lane calibration function is obtained that is employed in the next production engraving for this engraving lane (Fig. 6).

The actual printing densities D_{actual} achieved with the cups engraved in the test wedges and the potentially remaining residual deviations relative to the rated printing

20 densities D_{rated} are identified in (Fig. 3) after one or more renewed production engravings of a printing cylinder with the same engraving systems in the individual engraving lanes or are also identified at certain regular time intervals. In the way set forth above, an improved lane calibration function is calculated therefrom (Fig. 6), this then being employed in the following production engravings. Expediently, the

25 calculation of a new lane calibration ensues when the residual deviations between the rated printing densities D_{rated} and the actual printing densities D_{actual} have exceeded a prescribed tolerance limit. The calibration of the engraving lanes thus ensues in a process of "self-learning" wherein the settings of the engraving amplifiers in the individual engraving channels are continuously optimally adapted to the varying

30 technical boundary conditions such as, for example, differing degrees of wear of the engraving styli employed.

The inventive calibration method for density matching of the engraved lanes has been explained with reference to the example of setting the engraving channels with the transverse diagonals of the engraved cups. The method can be implemented in the same way when the transverse diagonal is replaced by some other geometry

5   value of the engraved test wedge cups, for example the longitudinal diagonals, the area or the volume of the cups. Analogous to the relationship of Fig. 2, a standard calibration function is employed for this purpose that places the geometry value employed into relationship with the rated printing densities D_{rated}. After setting the rated geometry values according to this standard calibration function, the actual

10   printing densities D_{actual} of the engraved test wedges are measured, and individual corrections of the geometry value employed are derived therefrom for the individual engraving lanes in order to erect a lane calibration function (analogous to Fig. 4 and Fig. 5).

An improved precision of the inventive calibration method can be achieved

15   when the setting of the geometry value employed ensues not only for the three characteristic rated printing densities but also ensues for further intermediate stages, for example for tonal values in a graduation of 10% between light and dark.

In another embodiment of the inventive calibration method, the signal values S with which the engraving channels are driven are individually corrected for every

20   individual lane instead of the geometry value employed. This is illustrated in Fig. 7 that shows the relationship between the signal values S and the printing densities D (see Fig. 1). The rated printing densities D_{rated} and the actual printing densities D_{actual} achieved in a specific engraving lane following the standard calibration are entered dependent on the drive signal values S. A signal value S = 80 (Point E) was applied

25   for driving for the value D_{rated} = 0.5 of the rated printing density. The actual printing density thus achieved is higher by the residual deviation ΔD (Point F). Corresponding deviations derived for the other characteristics tonal values for which the signal values S = 1 or, respectively, S = 161 had been applied in the engraving. When the points of the actual printing densities D_{actual} that were achieved for the three characteristic tonal

30   values are connected in this diagram, then the broken-line curve of the actual printing densities is obtained. According to the curve of the actual printing densities, the rated

printing density value D_{rated} = 0.5 is reached in the Point G, i.e. with a signal value deviating by ΔS = 15. When, thus, the corrected signal value S_{corr} = 80 + ΔS = 95 is applied in the next engraving in this engraving lane for the rated printing density value D_{rated} = 0.5, the rated printing density value D_{rated} is exactly achieved or is at least

5 achieved with far greater precision. Based on the same consideration, correction values ΔS for all signal values S can be derived from the comparison of the curves for the rated printing density D_{rated} and the actual printing density D_{actual}. An individual correction function S_{corr} = g(S) for the signal values ultimately derives therefrom for each engraving lane, this being shown in Fig. 8 for the example under consideration.

10 This correction function can, for example, be realized by a table memory in each engraving channel, a corrected signal value S_{corr} being allocated to every input signal value S therewith. In this embodiment of the inventive calibration method, care must be exercised to see that the actual printing density D_{actual} for the smallest signal values S has values that are higher than or equal to the rated printing density D_{rated}, since

15 negative signal values would otherwise have to be generated by the calibration. This condition can be assured, for example, by an enhanced pigmentation of the ink, whereby the pigmentation of the ink must be enhanced to such an extent that the above condition is met in all lanes.

In another development of the inventive calibration method, the time variation

20 of the residual deviations between actual printing density D_{actual} and rated printing density D_{rated} in the individual engraving lanes is additionally taken into consideration in order to make a prediction about the anticipated residual deviations and, thus, about the anticipated changes in the lane calibration function. One reason for the time variation is the progressive wear of the engraving stylus with age or, respectively, the

25 frequency with which the engraving stylus is used. Different degrees of wear of the engraving styli can be caused in that areas of different size were previously engraved in the engraving lanes and/or the engraving lanes exhibit different engraving properties that, for example, are to be attributed to a non-uniform galvanization of the printing cylinder.

30 Fig. 9 shows the time dependency for a lane of the transverse diagonals Q for the three characteristic tonal values to be set in the lane calibration according to the

inventive method. It is assumed that the transverse diagonals Q to be set were already redetermined at the respective time interval T for two matching periods of the lane calibration. A prediction for the variation of the transverse diagonals Q to be set in the next engravings can then be made (broken-line part of the curves) from the slope that

5 the curves have been reached at time 2T, the exact values being in turn determined from the measurement of the actual printing densities D_{actual} by time 3T. As a result of this extrapolation, the measurement and matching of the lane calibration need not be implemented as often. Instead of being entered dependent on the time, the variation of the geometry values relevant for the calibration can also be entered, for example,

10 dependent on the frequency with which the engraving styli are used in order to derive the prediction about the setting values for the next engravings. The frequency of the use can, for example, be measured in that the cumulated number of engraved cups is summed up in a counter that is present in every engraving channel. Alternatively, this number can also be determined in the control software and be stored.

15 In an advantageous embodiment of the invention, the measurements of the actual printing densities and the geometry values that are set are undertaken by automatic measuring devices. It is also advantageous to store and administer the measured values and the identified setting values for the individual lane calibrations as well as the time dependencies and development tendencies in a central computer, so

20 that the density match in between the individual engraving lanes automatically sequence it and is also automatically adapted to the change in technical boundary conditions over a longer time.

Patent Claims

1. Method for engraving printing cylinders in an electronic engraving machine, whereby

-- at least two engraving lanes that lie next to one another in axial direction are engraved on a printing cylinder with a respectively allocated engraving element,

-- signal values S that represent rated density values D_{rated} to be achieved are generated for the drive of the engraving elements,

-- the engraving elements driven with the signal values S engrave cups into the printing cylinder whose geometry values represents actual printing densities D_{actual} that have been achieved,

-- a standard calibration function is prescribed that describes the relationship between the geometry values and the rated printing densities D_{rated}, and

-- the electrical properties of the engraving elements are calibrated such that, given drive of the engraving elements with signal values S belonging to characteristic rated printing densities D_{rated}, cups having the geometry values prescribed by the standard calibration function are engraved,

characterized in that, for matching the printing densities in the individual engraving lanes,

-- cups with which the prescribed, characteristic rated printing densities D_{rated} are to be achieved are engraved in the printing lanes;

-- the actual printing densities D_{actual} achieved are identified by measurement after the printing;

-- a corrected lane calibration is derived for the respective engraving lane from the deviations between the rated printing densities D_{rated} and the actual printing densities D_{actual}; and

-- the allocated, corrected lane calibration is applied in every engraving lane.

2. Method according to claim 1, characterized in that the corrected lane calibration is generated in that corrected geometry values are determined for the rated printing densities D_{rated} in the standard calibration function.

3. Method according to claim 1 or 2, characterized in that the geometry values of a cup are the transverse diagonals, the longitudinal diagonals, the cup area or the cup volume.

4. Method according to claim 1, characterized in that the corrected lane calibration is generated in that corrected signal values S_{corr} are determined for the signal values S.

5. Method according to one of the claims 1 through 4, characterized in that improved, corrected lane calibrations are determined anew when the deviations between the rated printing densities D_{rated} and the actual printing densities D_{actual} exceed a tolerance limit.

6. Method according to one of the claims 1 through 4, characterized in that improved, corrected lane calibrations are determined anew after a prescribed time interval T, after a prescribed plurality of engraved printing cylinders or after a prescribed frequency of use of the engraving element.

7. Method according to one of the claims 1 through 6, characterized in that improved, corrected lane calibrations are determined by extrapolation from the time variation of the determined, corrected geometry values or, respectively, the corrected signal values S.

8. Method according to one of the claims 1 through 7, characterized in that the measurement of the actual printing densities D_{actual} and of the geometry values is implemented by automatic measurement devices.

9. Method according to one of the claims 1 through 8, characterized in that the measured values and the determined, corrected lane calibration functions as well as the time dependencies are stored and administered in a central computer.

10. Method according to one of the claims 1 through 9, characterized in that the corrected lane calibrations are continuously automatically adapted to the varying properties of the engraving elements and of the engraving lanes.

(54) Title: METHOD FOR ENGRAVING PRINTING CYLINDERS

(54) Bezeichnung: VERFAHREN ZUR GRAVUR VON DRUCKZYLINDERN

A SECTION CALIBRATION
B STANDARD CALIBRATION

Querdiagonale Q
TRAVERSE DIAGONAL Q
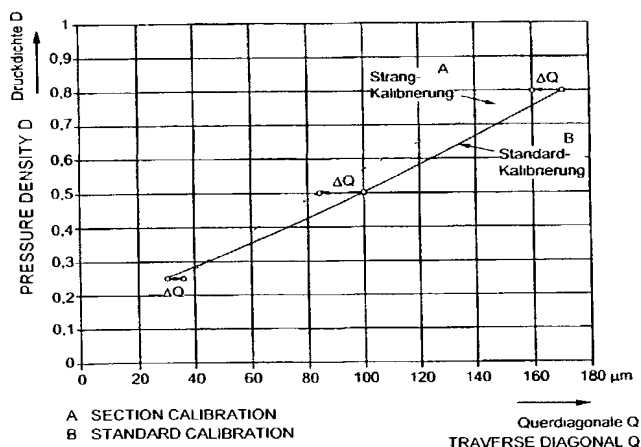
(57) Abstract: The invention relates to a method for engraving printing cylinders in an electronic engraving machine. According to said method, at least two gravure sections which lie adjacent to one another along the direction of the axis are engraved using a respective engraving organ. The electric properties of the engraving organ are adjusted using a standard calibration function in such a way, that during the operation of the engraving organ by means of signal values S belonging to characteristic predetermined pressure densities D_{pred}, cups are engraved with geometric values that have been predetermined by the standard calibration function. In order to standardise the pressure densities in the individual gravure sections, deviations between the predetermined pressure densities D_{pred} and the actual pressure densities D_{act} are determined and a corrected section calibration is derived for each gravure section. The corrected section calibrations are created by determining corrected geometric values or corrected signal values S from the deviations. The corrected section calibrations are used to continually adapt the calibration automatically to the changing characteristics of the engraving organs and the gravure sections.

(57) Zusammenfassung: Die Erfindung betrifft ein Verfahren zur Gravur von Druckzylindern in einer elektronischen Graviermaschine, bei dem auf einem Druckzylinder mindestens zwei in Achsrichtung nebeneinander liegende Gravierstränge mit jeweils einem zugeordneten Gravierorgan graviert werden, wobei die elektrischen Eigenschaften der Gravierorgane mit einer Standard-Kalibrierungsfunktion so eingestellt werden, dass bei Ansteuerung der Gravierorgane mit zu charakteristischen Soll-Druckdichten D_{soll}

[Fortsetzung auf der nächsten Seite]
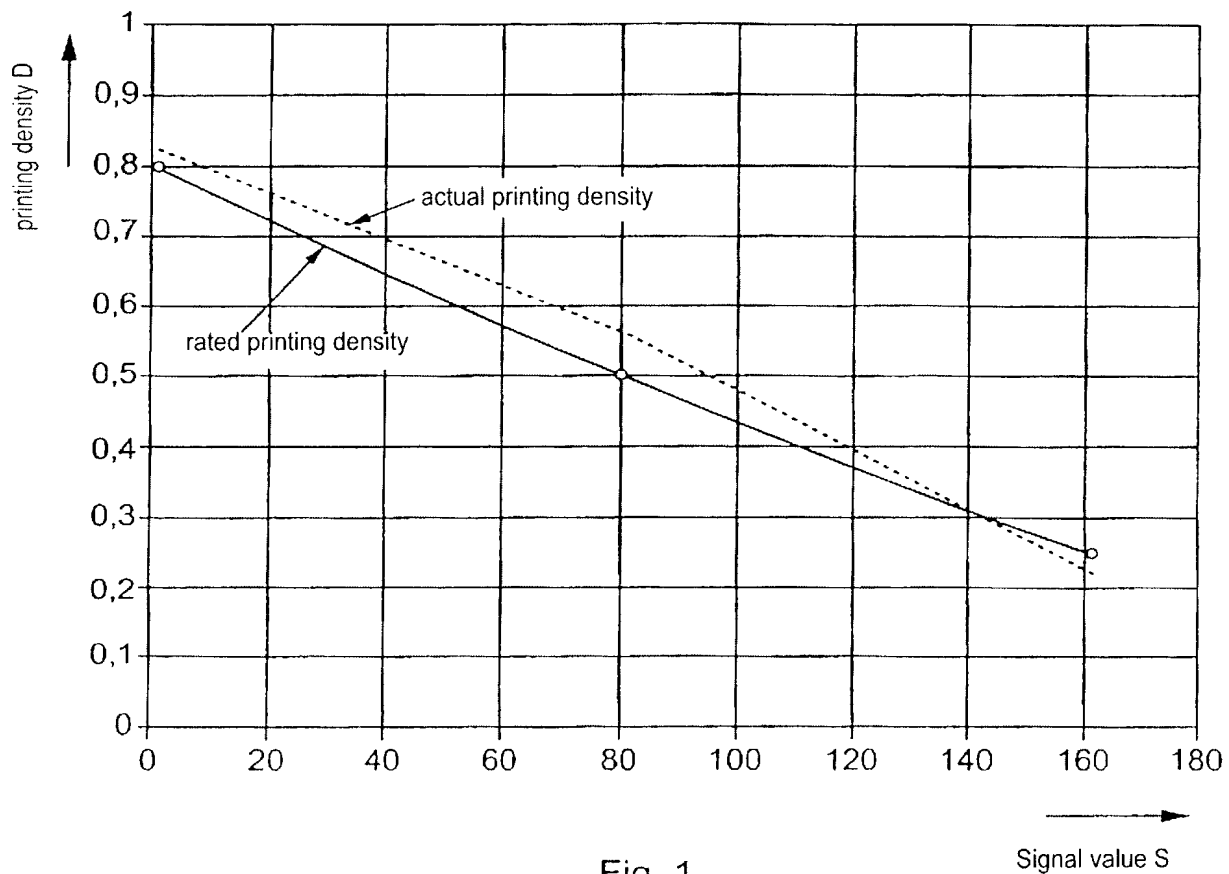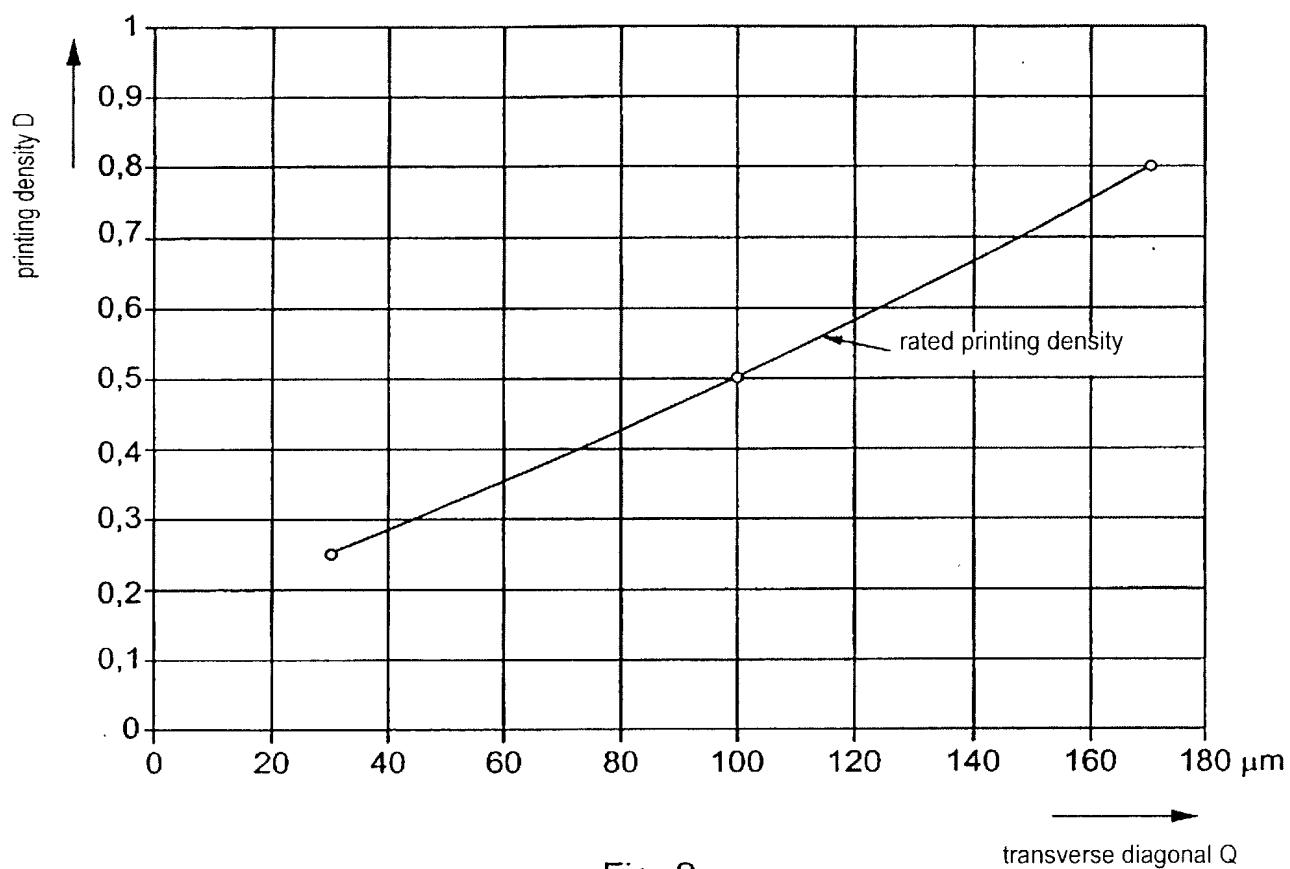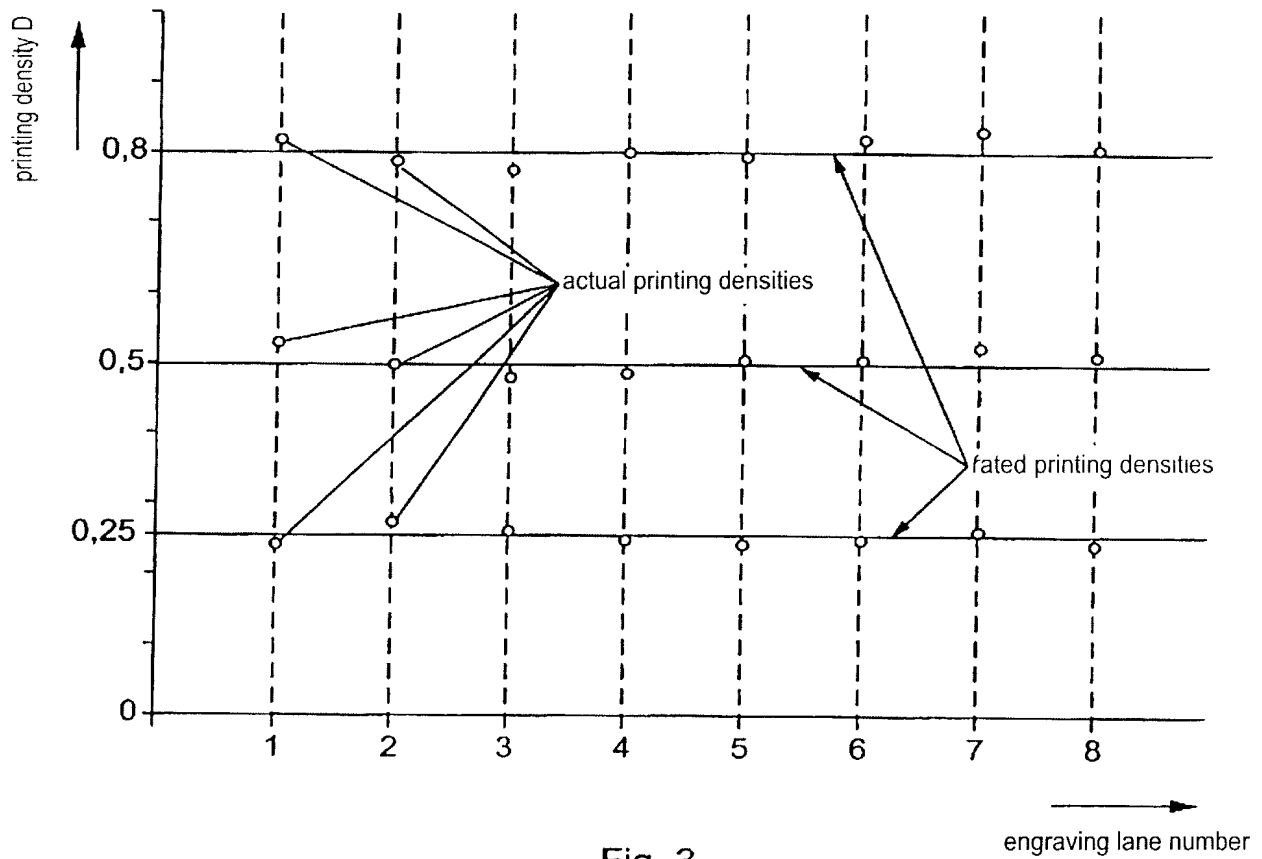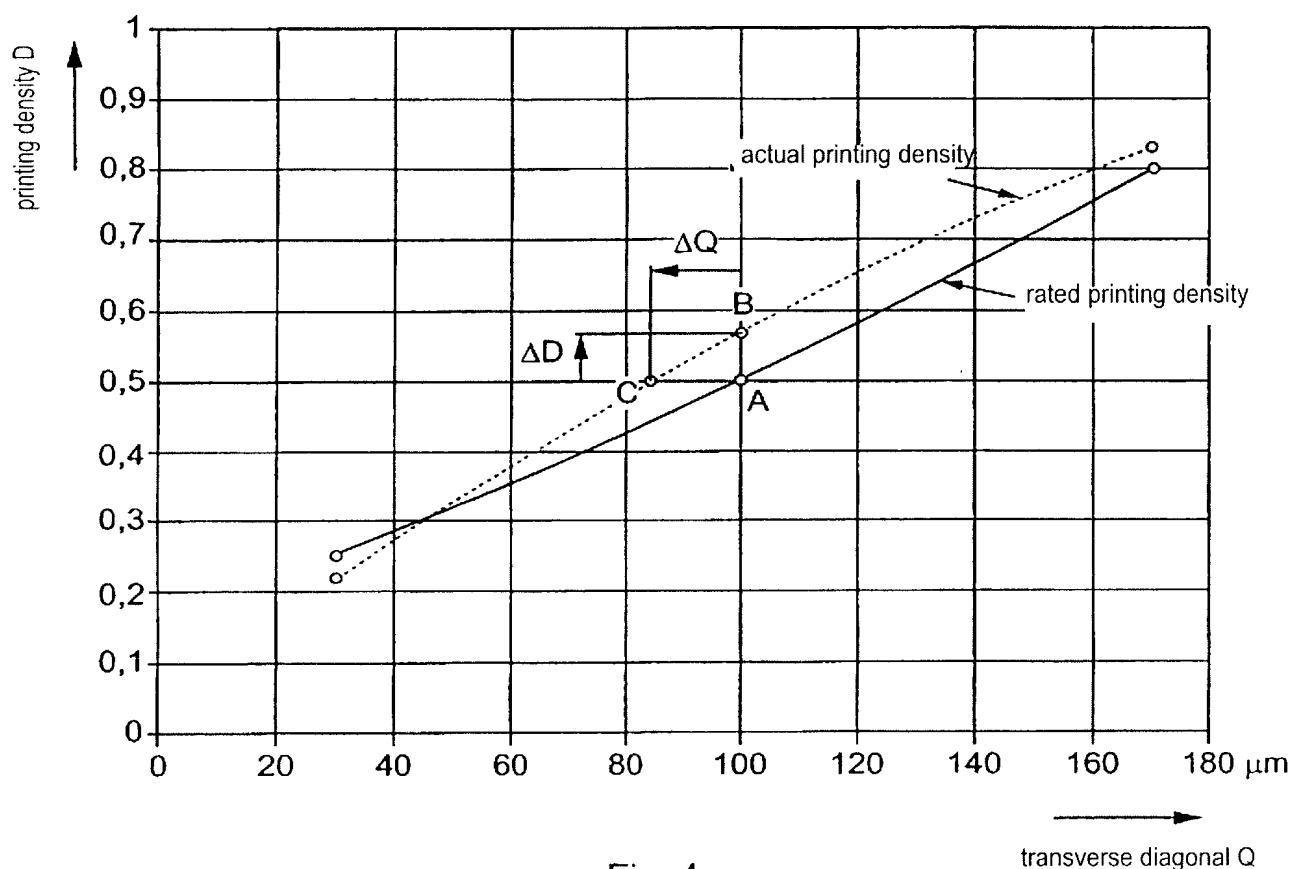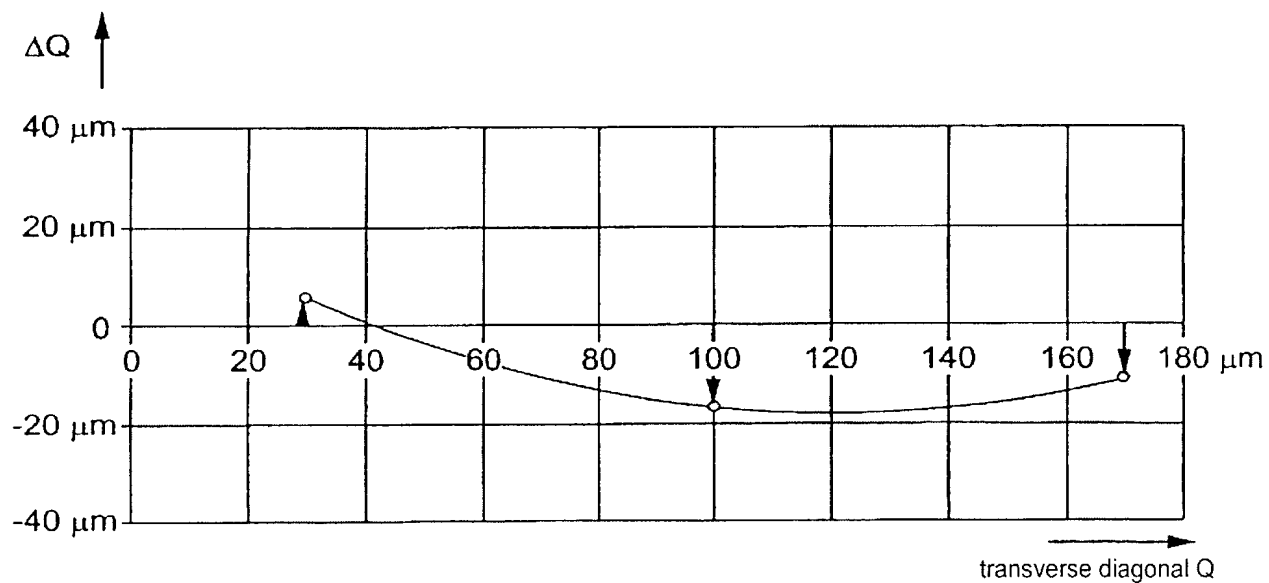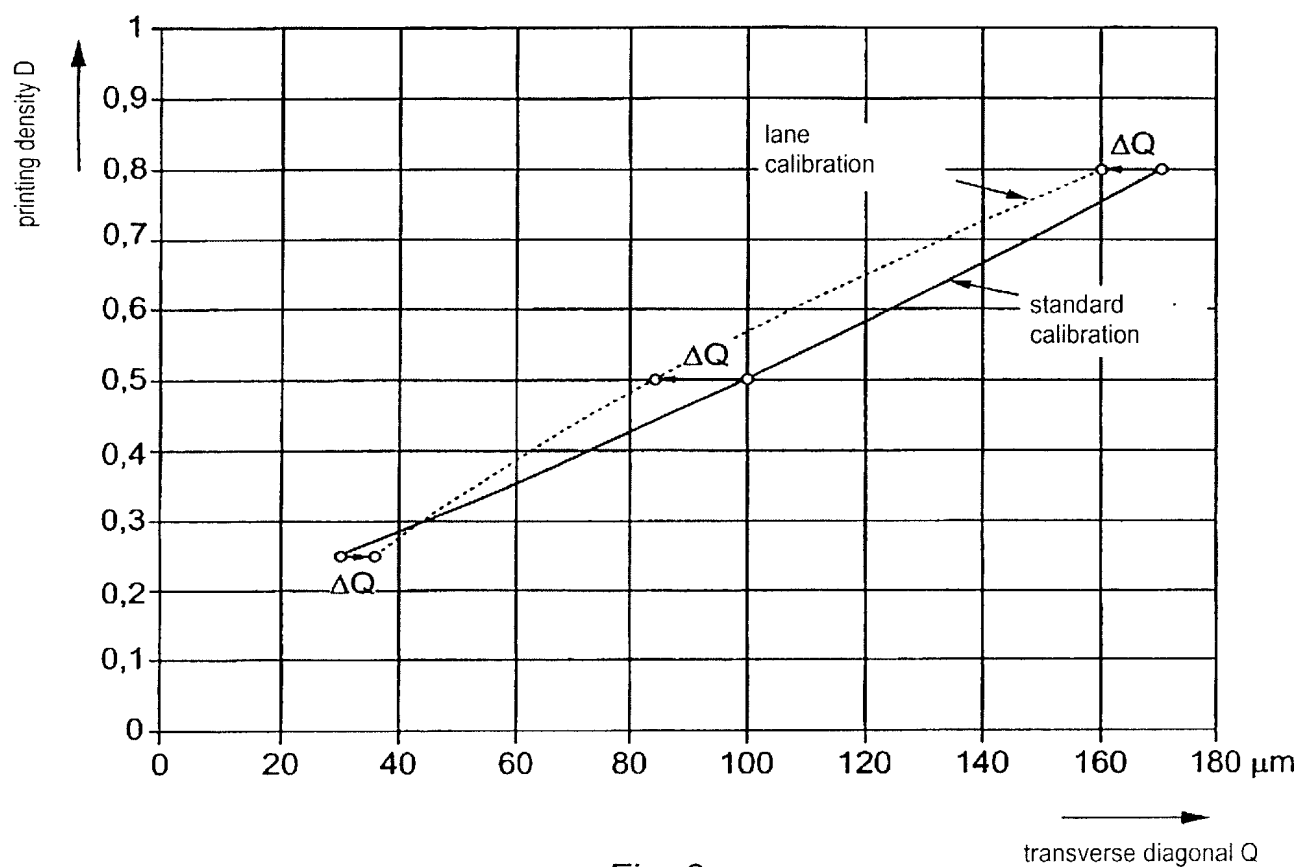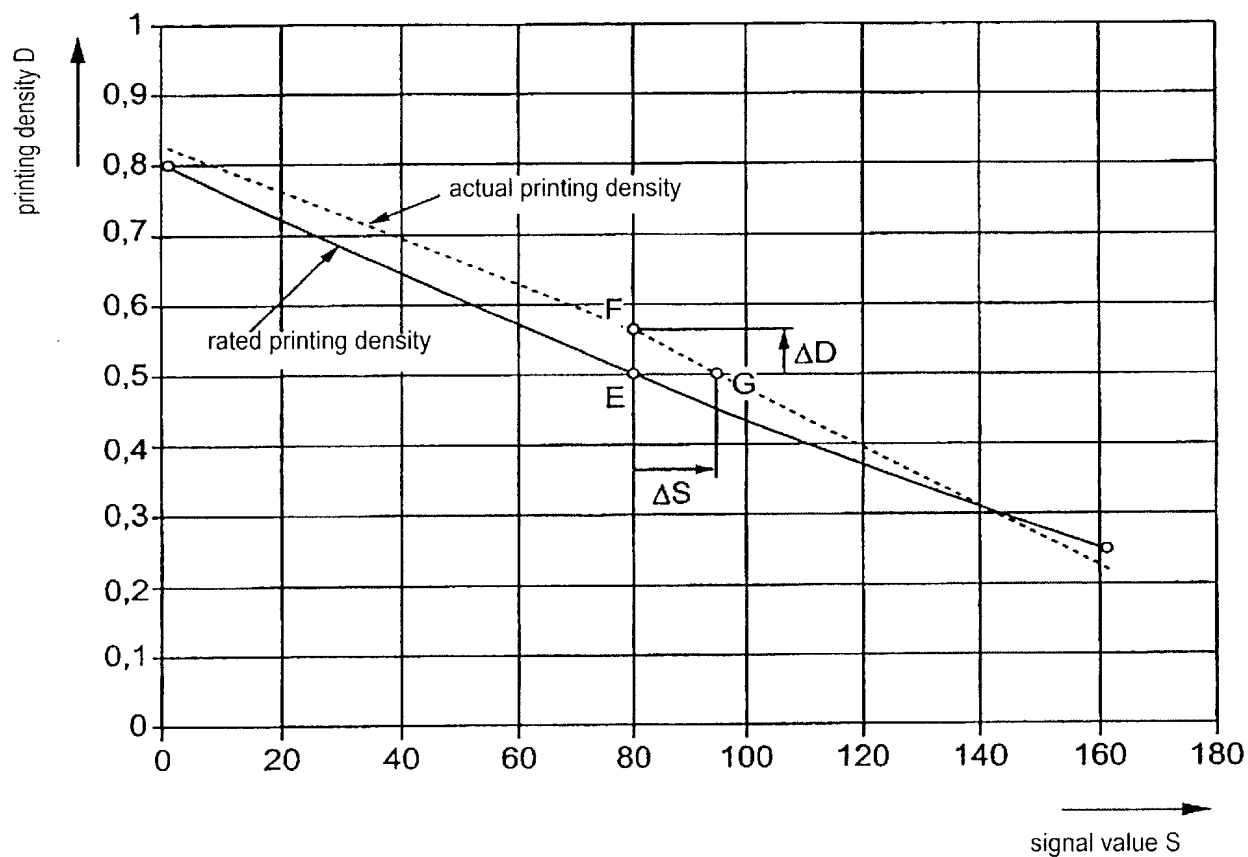
Fig. 1

Fig. 2

Fig. 3

Fig. 4
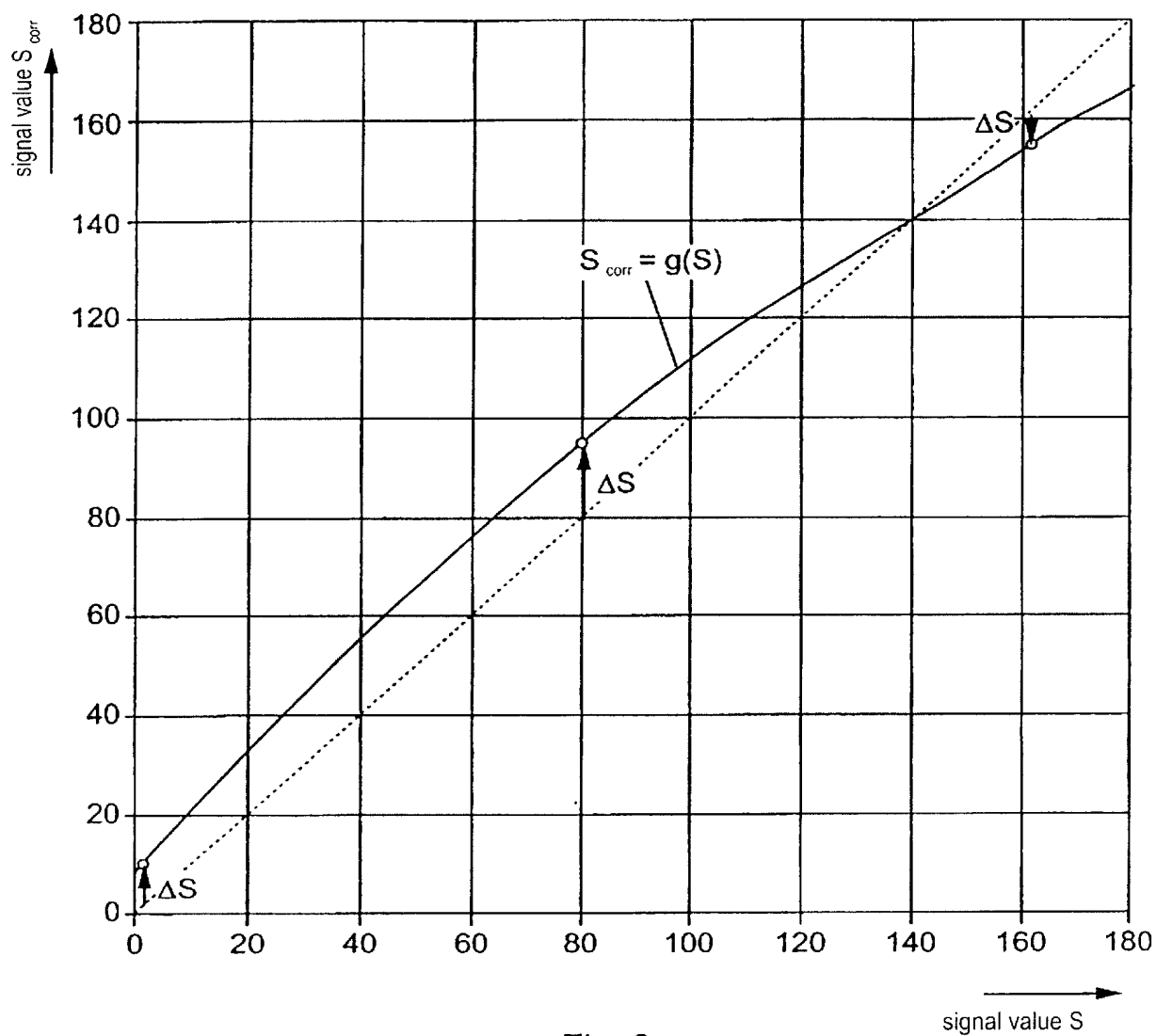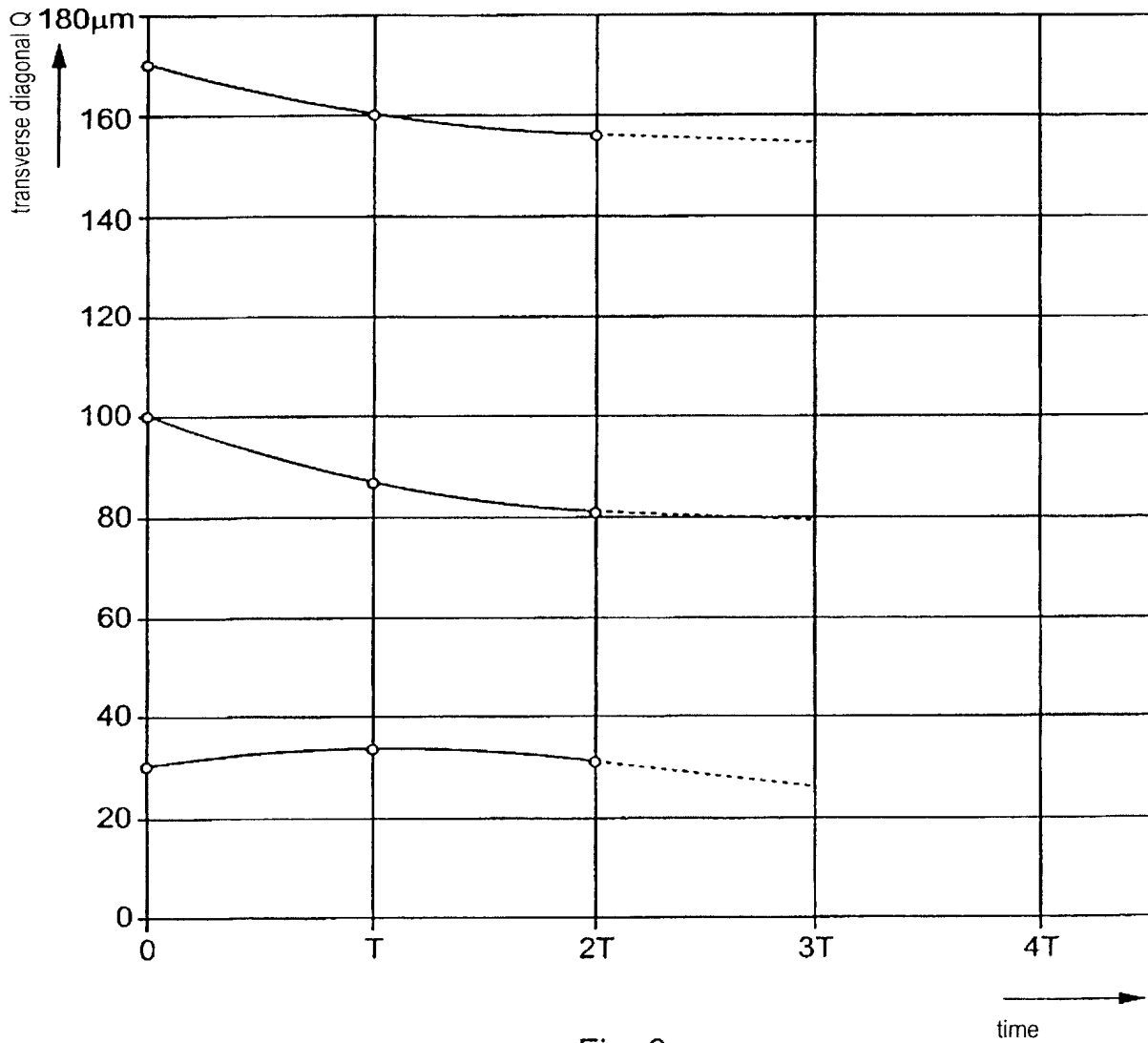

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER **P02,0000**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"METHOD FOR ENGRAVING PRINTING CYLINDERS"

the specification of which (check only one item below):

☐ is attached hereto.

☐ was filed as United States application
Serial No. _____

on _____,

and was amended

on _____(if applicable).

■ was filed as PCT international application

Number _____ PCT/DE00/03581 _____

on _____ 12 October 2000 _____,

and was amended under PCT Article 19

on _____(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	199 50 278.1	19 October 1999	☒YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NO P02,0000

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject mater of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, Untied States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint all Attorneys identified by United States Patent & Trademark Office **Customer Number 26574**, who are all members of the Firm Schiff Hardin & Waite.

Send Correspondence to: **SCHIFF HARDIN & WAITE** _ Patent Department **6600 Sears Tower, Chicago, Illinois 60606-6473**	Direct Telephone Calls to: (312) 258-5786

		FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
2 0 1	FULL NAME OF INVENTOR	WEIDLICH	Ernst-Rudolf	Gottfried
	RESIDENCE & CITIZENSHIP	CITY Kiel	STATE OR FOREIGN COUNTRY Germany	COUNTRY OF CITIZENSHIP Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS Fliegender Holländer 29	CITY 24159 Kiel	STATE & ZIP CODE/COUNTRY Germany
2 0 2	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 3	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201 Gottfried Weidlich	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 4.2.02	DATE	DATE